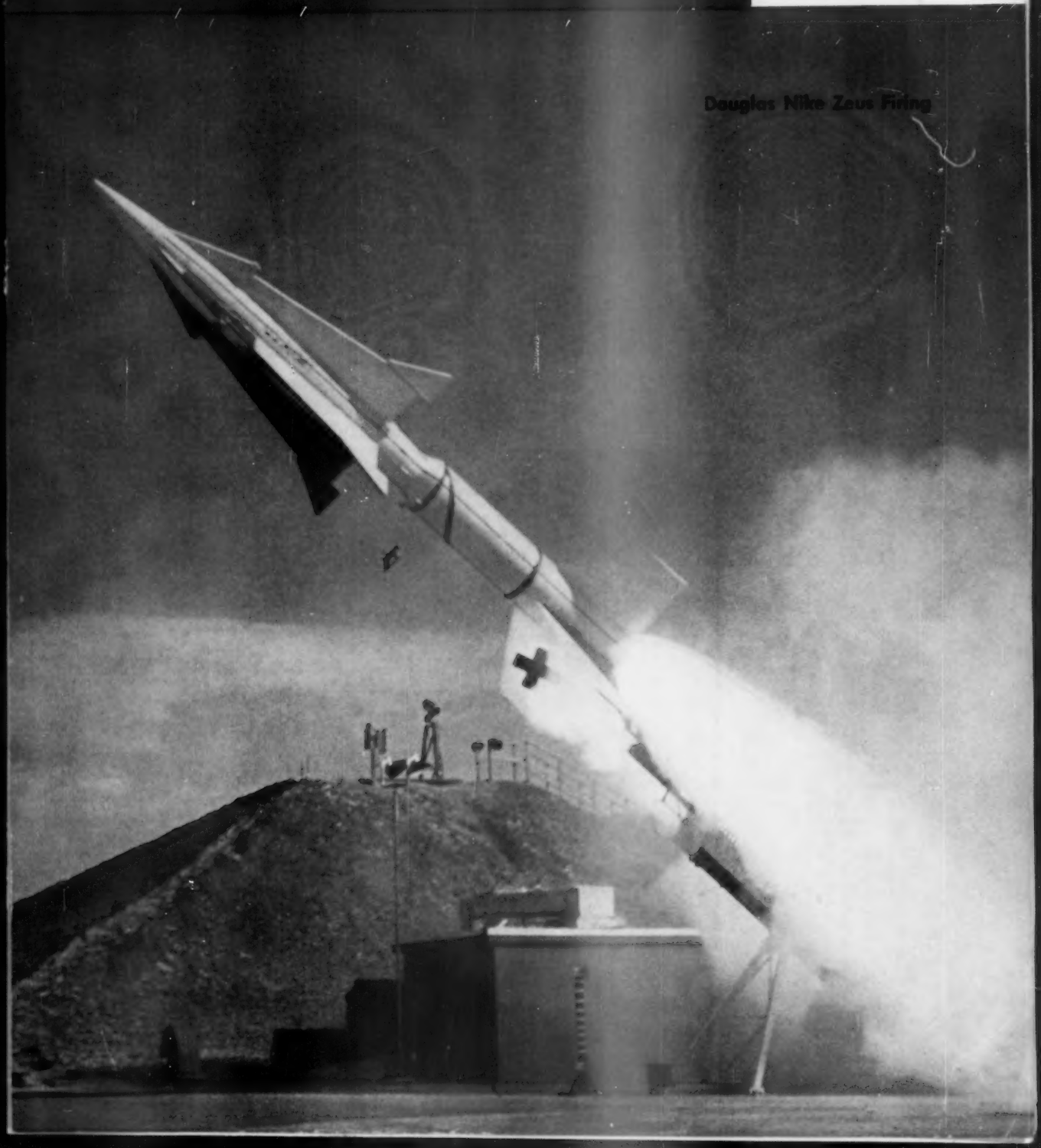
February 29, 1960

Aviation Week and Space Technology

National Product Indicator Of Passenger Gains



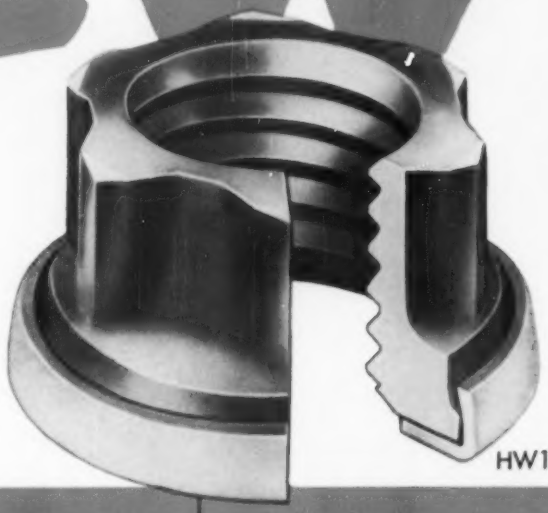
Douglas Nike Zeus Firing

9

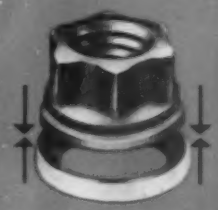
NEW

KAYLOCK® "CAPTIVE WASHER" NUT

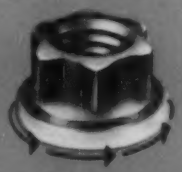
ENDS WASHER WANDERLUST



HW14



Enlarged view of Kaylock H14-3 and washer prior to assemblage.



Assembled HW14-3. Integral, free-spinning washer can't drop off. Only one part to buy instead of two.

Complete assemblage.

Service Temperature: 500°F. Tensile Strength: 160,000 PSI.

Material: Carbon Steel. Also in A286 for 900°F. applications.

Costly time is wasted on washers with wanderlust. Small, slippery, they roll away, drop off, slide into the hardest-to-get-at places. Now, Kaynar has solved the problem with the new Kaylock HW14 "Captive Washer" Nut, an H14 lightweight, all-metal, self-locking nut with integral, free-spinning, metal washer. Stabilizes frictional characteristics between nut base and aircraft structure. Result: controlled joint tightness.

Saves Assembly Time. Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers . . . *to zero.*

Safer too. There is no chance of equipment jamming or becoming destroyed because of nuts and washers vibrating loose. Kaylock HW14 nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a new product development of Kaynar Mfg. Co. Inc., world's oldest and largest manufacturer of lightweight, all-metal, self-locking nuts. For further information, contact your Kaylock representative or write or call Kaynar directly.

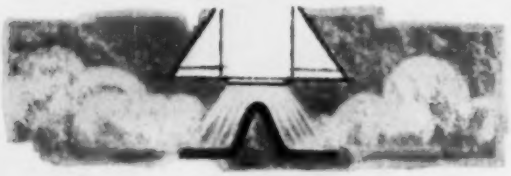
Trade Mark

Kaylock® ALL METAL SELF-LOCKING NUTS — *first in lightweight locknuts*

Kaynar Mfg. Co. Inc., Kaylock Division, Box 2001, Terminal Annex, Los Angeles 54, Calif.
Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Washington. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

Need a **NONCRITICAL** *material to solve a* **CRITICAL** *heat problem?*

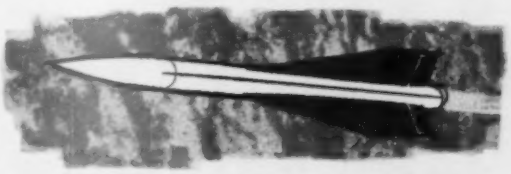
Consider these Goodyear Aircraft capabilities in the field of high-temperature laminates –



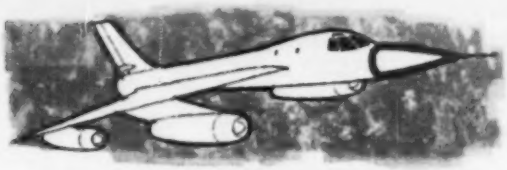
HERE'S AN INEXPENSIVE BLAST DEFLECTOR – made of reinforced plastic – which can withstand the direct blast of a rocket engine. Goodyear Aircraft stands ready to design and fabricate economical, reusable blast deflectors to your specific requirement.

CRYOGENIC FUEL TANK INSULATION by Goodyear Aircraft is less than ¼-inch thick, yet has proved its ability to prevent "boil off" of liquid gaseous rocket fuels, such as liquid nitrogen and liquid hydrogen. Use of a plastic laminate for this purpose can mean substantial weight, space and cost savings.

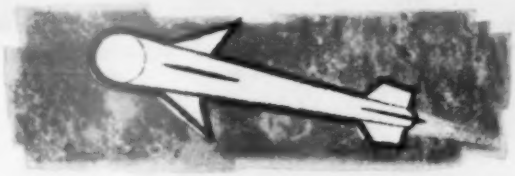
NOSE CONES FOR GLIDE RE-ENTRY VEHICLES can be produced at Goodyear Aircraft to a wide range of specifications. The reason: extensive experience with ablative and thermal-resistant techniques. Do you need a lightweight nose cone material that can withstand 2000° to 2500° for an hour or more? Whatever your re-entry requirement, a specially compounded high-temperature laminate may well be the answer.



LEADING EDGES OF MISSILES or aircraft can be protected against prolonged high-temperature exposure by plastic laminate coverings which conform to the metal structure. Reinforced plastic laminates by Goodyear Aircraft can also be used for jet vanes, rocket nozzles, fins and other miscellaneous missile components.



RADOMES FOR AIRCRAFT which operate at Mach III and above have been produced at Goodyear Aircraft. Goodyear Aircraft has a vast background in radome engineering and manufacturing for both the solid and honeycombed layered constructions.



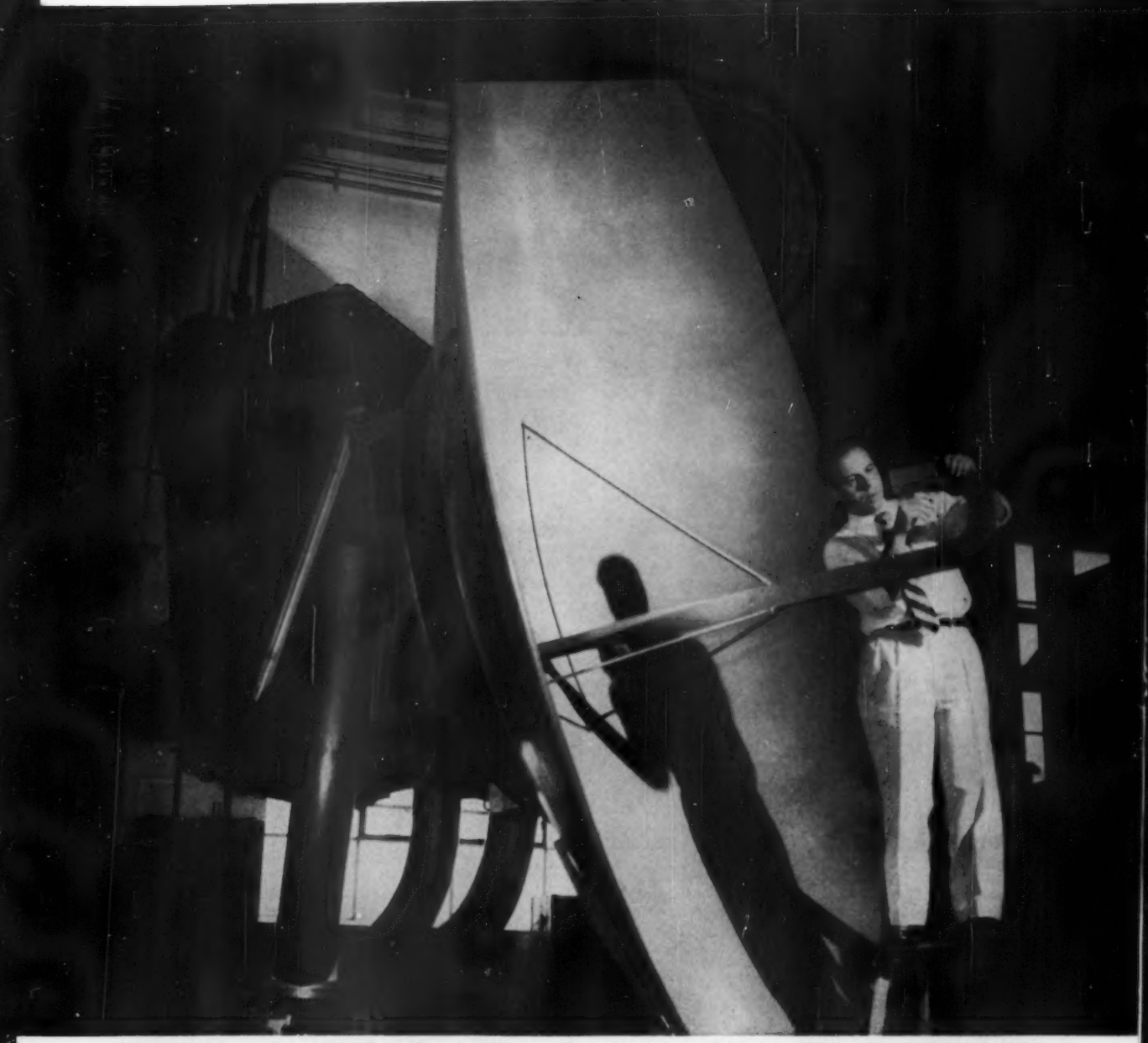
"PLASTIC" MISSILES – built by Goodyear Aircraft – could utilize a variety of plastic laminates and fabrication techniques. Advantages of such all-plastic components: no use of critical material, high strength-to-weight ratio, low cost in mass production, rust- and corrosion-resistant.

Your inquiry is invited *regarding these specific capabilities – or any requirement calling for a noncritical, high-strength material which must retain its properties under the most demanding heat and stress conditions. WRITE: Goodyear Aircraft Corporation, Dept. 916AN, Akron 15, Ohio.*

ENGINEERED PLASTICS *– ONE OF THE PRIME CAPABILITIES OF*

GOODYEAR AIRCRAFT

PLANTS IN AKRON, OHIO, AND LITCHFIELD PARK, ARIZONA



Twelve-foot diameter dish of WSR-57 "Stormfinder" radar. System operates at S band, has 250-mile range, 500 Kw output.

Now being delivered to the U. S. Weather Bureau are WSR-57 weather detection radars. Each unit covers 200,000 square miles, tracks storms, identifies rain, snow and fog. This equipment is designed and produced by Raytheon.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

Mar. 7-8—Fifth Annual Business Aircraft Safety Seminar, Dearborn Inn, Dearborn. Sponsor: Flight Safety Foundation.

Mar. 9-10—Symposium on "Processing Materials for Re-Entry Structures," Miami Hotel, Dayton, Ohio. Sponsor: Midwest Chapter, Society of Aircraft Material & Process Engineers.

Mar. 9-11—Conference on the Mechanical Properties of Engineering Ceramics, North Carolina State College, Raleigh, N. C. Sponsors: North Carolina State College School of Engineering; Office of Ordnance Research, U. S. Army.

Mar. 10-11—National Flight Propulsion Meeting (classified Secret), Institute of the Aeronautical Sciences, Cleveland.

Mar. 14-15—Symposium on Load-Carrying Capacity of Bearings, American Society of Mechanical Engineers' Lubrication Division, Engineering Societies Building Auditorium, New York, N. Y.

Mar. 15—Defense Planning Seminar, Electronic Industries Assn., Statler-Hilton Hotel, Washington, D. C.

Mar. 17-18—Synchro Design and Testing Symposium, Department of Commerce Auditorium, Washington, D. C. Sponsor: Navy Dept., Bureau of Naval Weapons.

Mar. 21-24—Institute of Radio Engineers' International Convention, Waldorf Astoria and Coliseum, New York, N. Y.

Mar. 23-25—Symposium on Optical Spectrometric Measurement of High Temperatures, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation.

Mar. 23-25—Ground Support Equipment Conference, American Rocket Society, Statler-Hilton Hotel, Detroit, Mich.

Mar. 24-25—First Annual Symposium on Human Factors in Electronics, New York, N. Y. Sponsor: Institute of Radio En-

(Continued on page 6)

AVIATION WEEK and Space Technology

February 29, 1960

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Miniature Directional Gyro
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Electronics
DIVISION OF
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2838 S.E. NINTH AVENUE, PORTLAND 2, OREGON
Terrier missiles manufactured by CONVAIR, Pomona, a division of General Dynamics.

AVIATION CALENDAR

(Continued from page 5)

gineers' Professional Group on Human Factors in Electronics.

Apr. 5-8—1960 National Aeronautic Meeting and Missiles and Aircraft Engineering Display, Society of Automotive Engineers, Commodore Hotel, New York.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 11-13—Electrical Engineering in Space Technology, Hotel Baker, Dallas, Tex. Sponsor: American Institute of Electrical Engineers.

Apr. 12-13—14th Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Hotel Alms, Cincinnati, Ohio.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 20-22 — National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge Marriott Motor Hotel, Washington, D. C.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

Apr. 28-29—Symposium on "Closed Circuit Respiratory Systems," Wright Air Development Division, Wright Patterson AFB, Ohio.

May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.

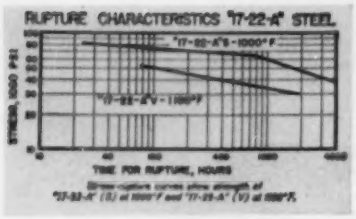
May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm, Sweden.

High alloy performance with Timken® low alloy steel



You keep maximum strength up to 1100°F. If you are using expensive, high alloy steels for missile engine parts, aircraft brakes, gas turbines or other high temperature applications, try Timken® *low* alloy "17-22-A" steels. On less than 3% alloy content, you get high alloy performance—with maximum strength up to 1100°F.

Besides cutting your initial costs, Timken "17-22-A" steels have high resistance to heat checking and thermal cracking. They are readily workable up to 2300°F. and are easily machined and welded. In fact, maximum high temperature properties can be developed by normalizing and tempering. You practically eliminate the chance of distortion and quench cracking.

Want more details on this money-saving steel? Send for Technical Bulletin 36B. And let our metallurgists help solve your high temperature steel problems. They've solved thousands already. ***When you buy Timken steel you get:*** 1) *Quality that's uniform from heat to heat, bar to bar, order to order.* 2) *Personal attention from the experts in specialty steels.* 3) *Over 40 years' experience in solving tough steel problems.* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

Timken Alloy Steel and Seamless Steel Tubing are available from warehouse stocks in 44 cities in the United States.

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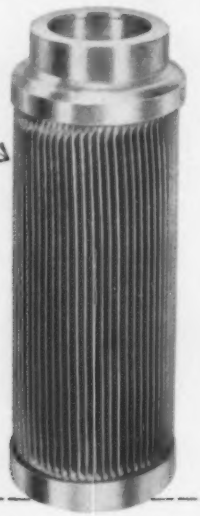

Only Pressure Lock will do it, and this is why:

Pressure Lock is an exclusive Purolator process of assembling a wire-mesh filter medium without welding, brazing or cementing, and without the contamination that any of these methods produce. Pressure Lock embeds the filter medium in the end caps in an absolute bond that contains no material other than the metal of the cap and filter medium. As a result, the only limitation on the performance of a Pressure Lock filter – temperature, pressure, vibration, filtration or weight – is the physical properties of the construction metals.

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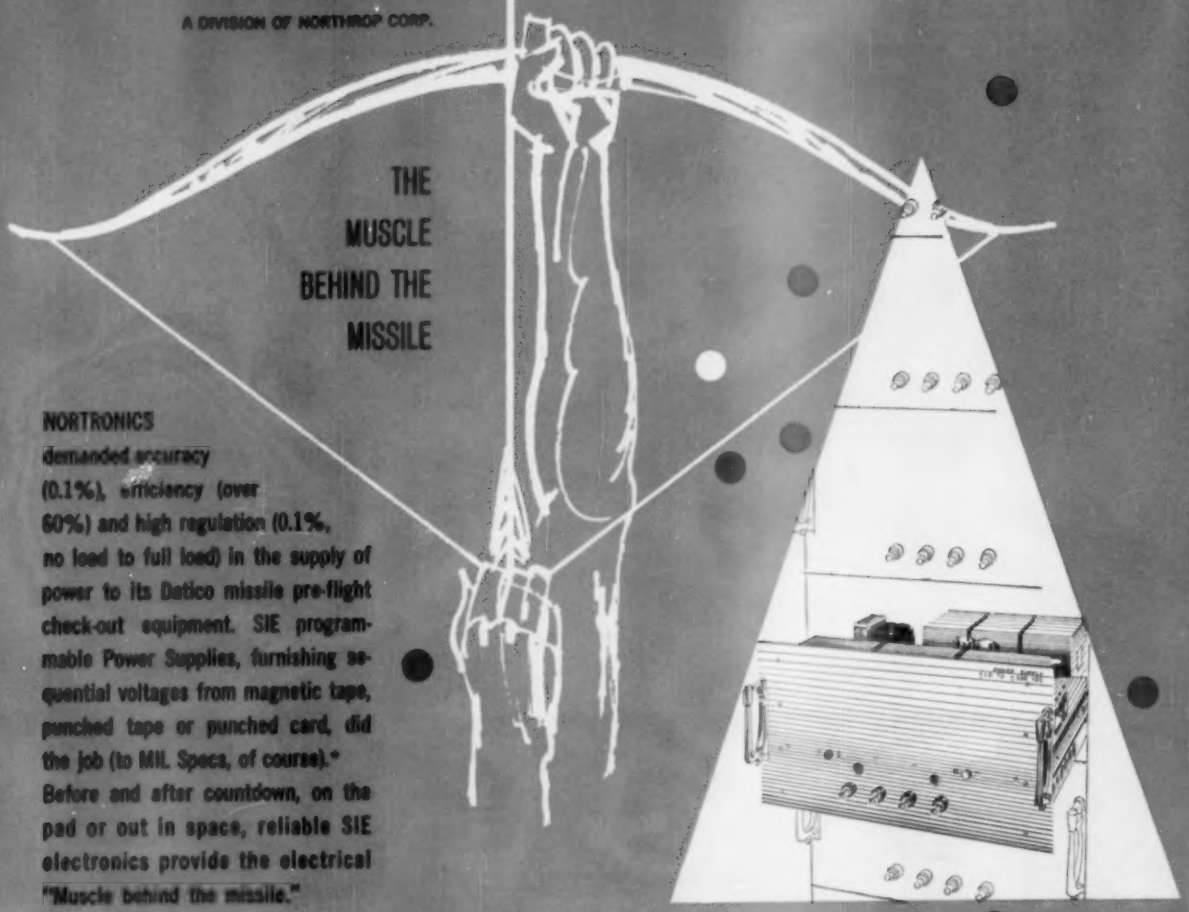

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Better than 0.1% overall accuracy
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Better than 0.1% regulation
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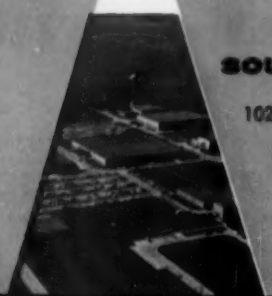
PS-33 — 1 to 500 vdc in 1 volt steps, 1 amp
PS-34 — 0 to 99.9 vdc in 0.1 volt steps, 1.5 amps



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Our acoustical engineers have developed three individual degrees of soundproofing installations for the Gulfstream to insure the comfort level you desire. And our highly experienced, well-equipped radio and electronics departments design and execute the most modern installations.

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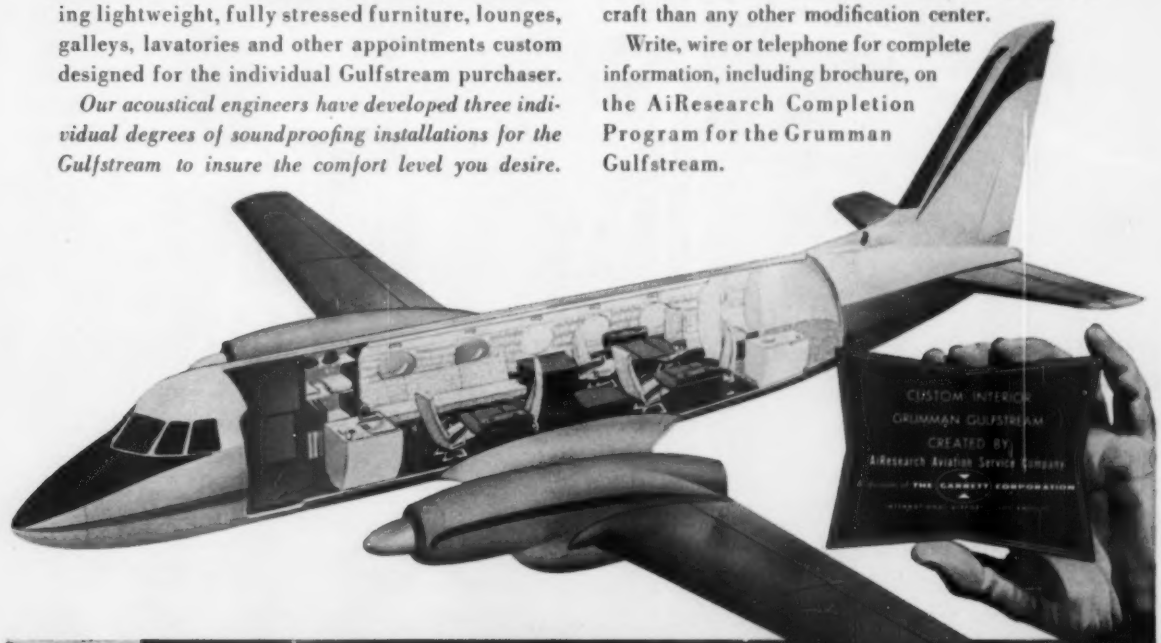
AiResearch has more experience in pressurized aircraft than any other modification center.

Write, wire or telephone for complete information, including brochure, on the AiResearch Completion Program for the Grumman Gulfstream.



Grumman Gulfstreams undergoing a custom tailored completion program at the AiResearch Aviation Service Company facility.

THE GARRETT CORPORATION

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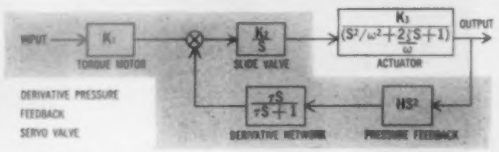

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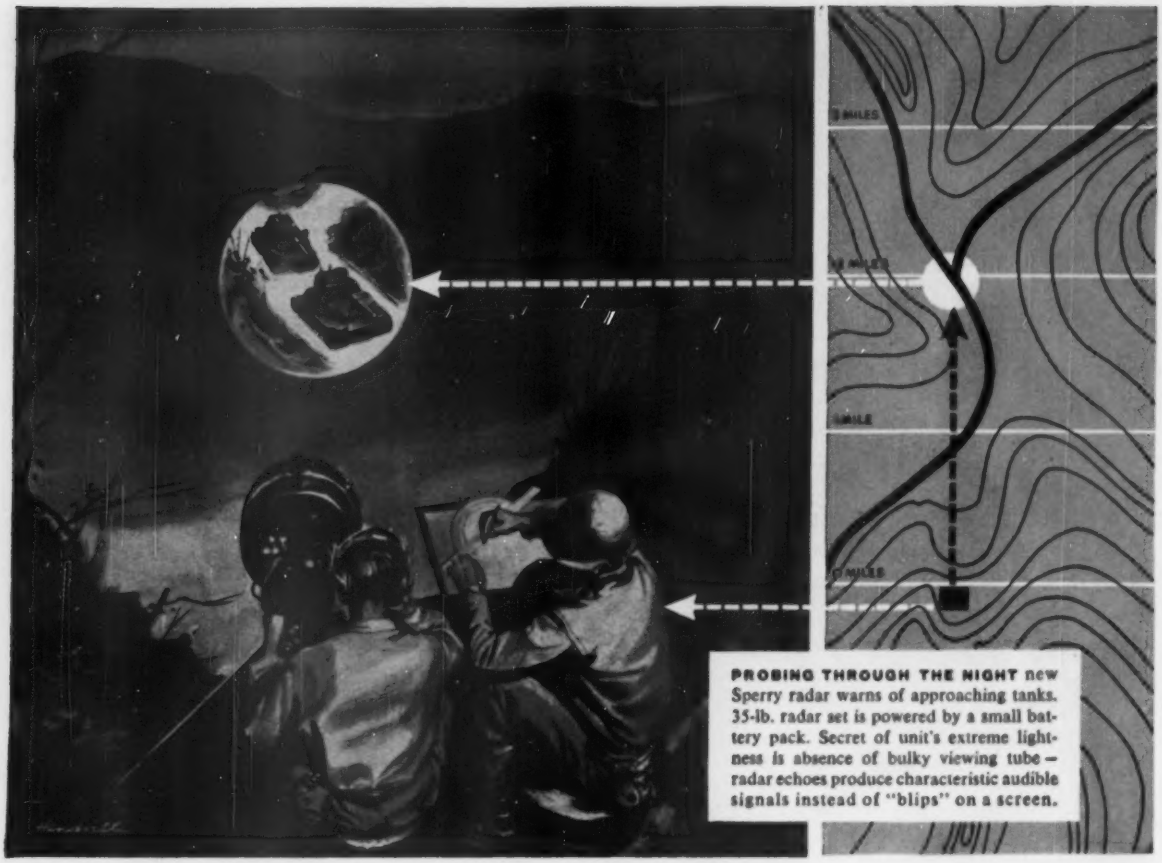

PROBING THROUGH THE NIGHT new Sperry radar warns of approaching tanks. 35-lb. radar set is powered by a small battery pack. Secret of unit's extreme lightness is absence of bulky viewing tube – radar echoes produce characteristic audible signals instead of "blips" on a screen.

Army has "Silent Sentry" Radar for front-line use

SPERRY RADARS range in size from the tiny "Silent Sentry" (above) to the giant Air Force Early Warning Radar, the AN/FPS-35 with its 85 ft. tower and 126 ft. antenna. These towers of strength in U.S. defenses will be spotted strategically throughout main Air Force defense networks.

Army troops are now able to call upon the country's first production equipment of this size. The device – designed to warn of surprise over-the-ground infiltration or major attack by an aggressor–greatly enhances the effectiveness of battle area surveillance.

Developed jointly with the Army Signal Corps, this new Sperry portable radar instantly reports any movement of men or vehicles within a three-mile range–at night, in fog or smoke. So accurate is the set that it can detect one soldier walking a mile away and can distinguish between a single individual and a squad of several men. It is also sensitive enough to determine the approximate size of a vehicle target and indicate whether it has wheels or tracks. This new "Silent Sentry" is one more result of the joint efforts of our military leaders and Sperry to keep our defenses up-to-date.

The "Silent Sentry" (AN/PPS-4) is one of a broad variety of radars manufactured by the Surface Armament Division of Sperry Gyroscope Company.

SPERRY

SURFACE ARMAMENT DIVISION, *SPERRY GYROSCOPE COMPANY · DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, N.Y.*

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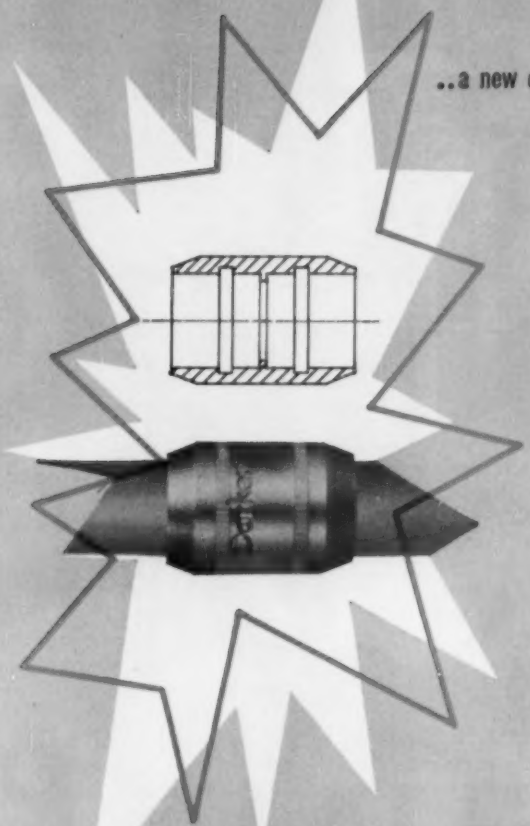

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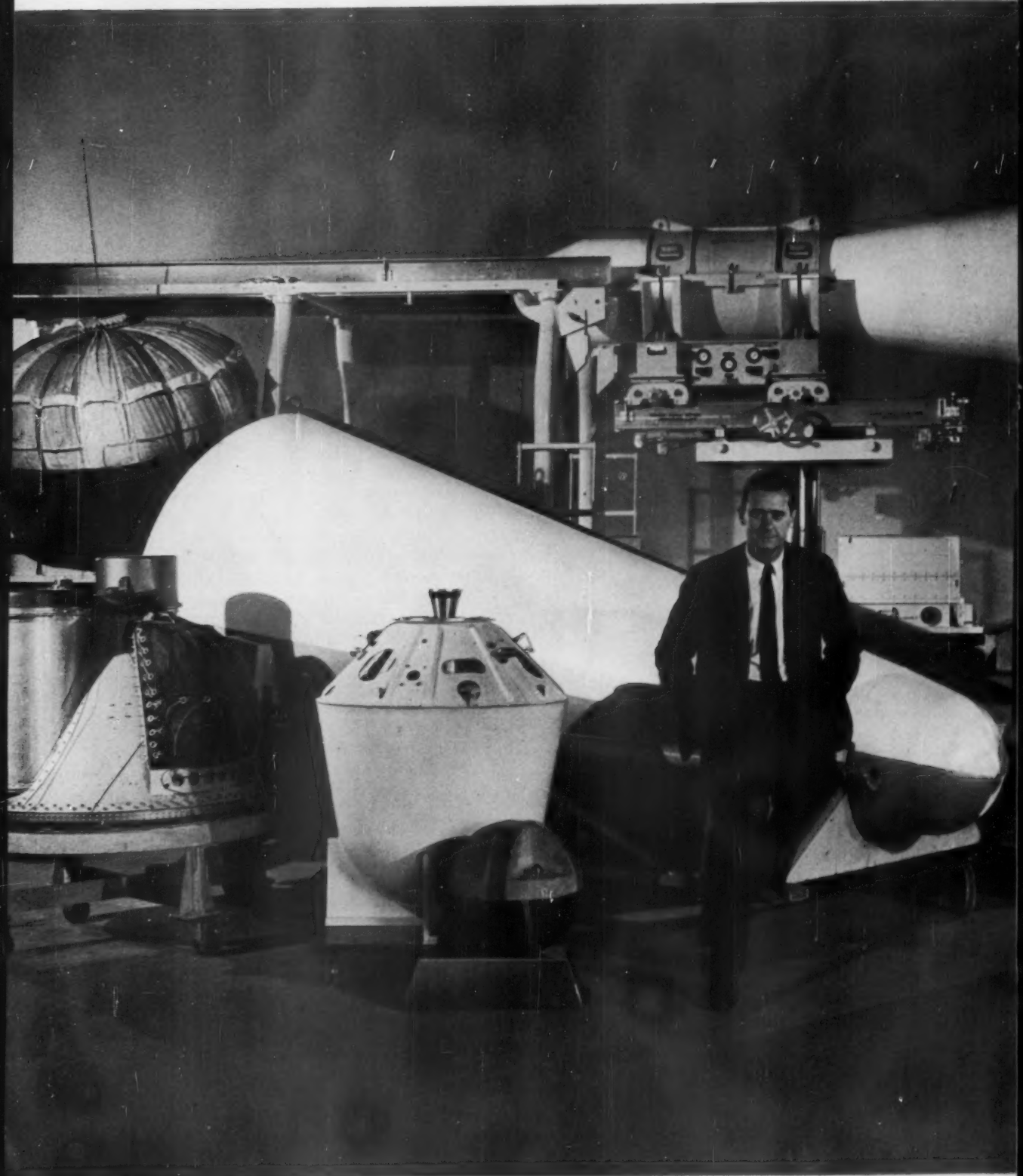
PARKER AIRCRAFT CO. FLUID-SYSTEM COMPONENTS

4000 subcontractors are represented
re-entry vehicle "family portrait"



in this unique dramatizing . . .

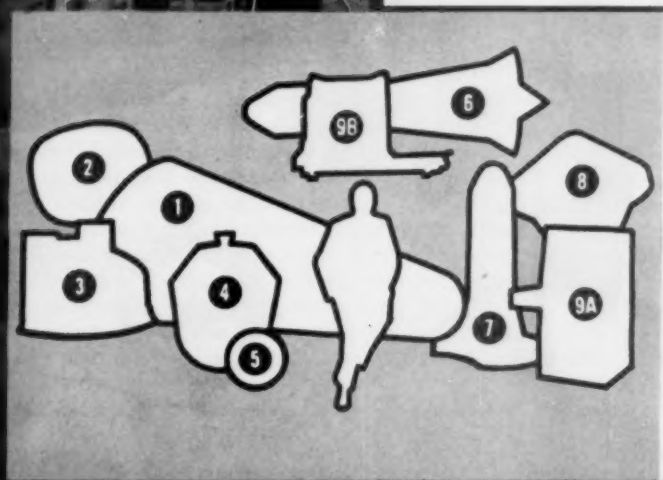
4 years of USAF, G.E., SUBCONTRACTOR re-entry vehicle progress

The key to this progress has been teamwork . . . teamwork between General Electric's Missile and Space Vehicle Department, the Ballistic Missile Division and the Ballistic Missile Center of the United States Air Force and the over 4000 small and large subcontractors alike who have helped MSVD make so many vital contributions to U.S. re-entry vehicle progress.

IN 1959 ALONE, the following figures indicate the emphasis MSVD placed upon this important factor of subcontractor teamwork on Air Force projects.

- Over 35,000 different purchase orders were placed by MSVD on subcontractors in 1959.
- More than 25,000 of these MSVD purchases were made from "small" subcontractor businesses.
- More than $26,000,000 worth of goods and services were purchased by these 35,000 orders. This amount represented a major portion of the contract dollars received by MSVD.
- And more than $13,000,000 of this $26,000,000 went to "small" business firms.

If you'd like more information about G.E.'s Missile and Space Vehicle Department . . . its subcontracting activities, its re-entry vehicle programs or about any of its space technology activities . . . write to Section 160-70, G.E. Missile and Space Vehicle Department, 3198 Chestnut Street, Philadelphia 4, Pa.



Mr. Hilliard W. Paige, General Manager, Missile and Space Vehicle Department with Air Force re-entry vehicles developed by MSVD.

1. RVX-2 Re-entry/Recovery Vehicle, the largest ablation-type re-entry vehicle to travel full ICBM-range and be recovered.
2. Flotation balloon used in recovering USAF-MSVD research re-entry vehicles.
3. Recovery equipment package for RVX-2.
4. Satellite Aeromedical Re-entry/Recovery Vehicle for USAF Discoverer Program.
5. Mark-2 recoverable Data Capsule which flew in Thor re-entry vehicle and returned first films from outer space.
6. Mark-3, an advanced operational-type re-entry vehicle for Atlas.
7. RVX-1, first ablation-type re-entry vehicle to be recovered after full ICBM-range flight.
8. Mark-2, first U.S. operational heat-sink re-entry vehicle now in use on USAF Thor and Atlas missiles.
9. Typical ground support equipment developed by MSVD for USAF use. (A) Mark-2 prelaunch check-out console. (B) Mark-3 missile mating equipment.

MISSILE AND SPACE VEHICLE DEPARTMENT

GENERAL ELECTRIC

A Department of the Defense Electronics Division

THE LOCKHEED JETSTAR
FLIES AS FAST AND AS RELIABLY
AS THE BIG JETLINERS

AND PRATT & WHITNEY
AIRCRAFT JET ENGINES
HELP MAKE IT ALL POSSIBLE

The new Lockheed JetStar is the jet that goes where you want to go, when you want to go. It has intercontinental capabilities, yet can land at the smaller airports. Powering the JetStar are four Pratt & Whitney Aircraft JT12 engines. Weighing only 436 pounds but developing 3,000 pounds thrust, the JT12 is one of the most efficient power plants ever developed. And it's one of the most reliable, too. Its simple, rugged design means easy maintenance and high operational reliability. Backed up by Pratt & Whitney Aircraft's world-wide service, the JT12 is an engine conceived, designed and built for business use.

PRATT & WHITNEY AIRCRAFT
East Hartford, Connecticut
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XXX

This is the thirtieth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Evaluating the Machinability of Alloy and Carbon Steels

To produce a useful part, most steel has to be shaped by one or more of the metal forming methods. One of these is metal cutting or machining, which changes the shape, size, or finish of a workpiece.

Alloy or carbon steels are often received from the mill in the raw form of bars, forgings, or castings. The steel is placed in a suitable machine, such as a lathe, multiple-spindle automatic bar machine, drill press, milling machine, or one of a number of other types. Metal is then removed from the steel stock until it has acquired the desired shape. This is accomplished by causing motion to take place in the sharp-edged cutting tool, or the piece of steel, while they are held in contact with each other. Cutting tools, such as drills, tool bits, milling cutters, and the like, are made from highly-alloyed steel (tool steel), cast alloys, sintered carbide, or even ceramic material.

During machining, the metal is removed in the form of chips which may be of any length, from the short, well-broken type, to the long, stringy and continuous variety—depending upon the nature of the steel, the shape or geometry of the cutting tool, the speed and feed at which the cutting is done, and the coolant or cutting fluid applied.

"Machinability" of steel refers primarily to the ease with which it can be reduced to its final shape. It is measured by the speed and feed at which it can be cut, the quality of the surface finish produced, the length of time the tools will last, and the kind of chip formed in cutting. In a "free-machining" grade of steel, for example, high speeds and feeds can be used, tools will stand up well, surface finish will be good, and chips well broken.

Machinability is evaluated in the shop by the number of pieces having a satisfactory finish, within the required dimensional tolerances, that can be produced in a shift, or a day, with adequate tool life.

It can be appreciated that the study of the cutting of metals involves a large number of variables. These may be grouped in the following way:

1. Steel Analysis (Process, composition, microstructure, and mechanical properties)
2. Machine Tool (Condition, tool accessories, range of cutting speeds and feeds with ample power, etc.)
3. Type of Machining Process (Turning, milling, forming, broaching, etc.)
4. Cutting Condition (Speeds, feeds, and depth of cut)
5. Cutting Tool (Composition, treatment, hardness, size, shape, grinding and surface finish)
6. Cutting Fluid (Characteristics, application, and volume)

From this number of complex factors, laboratory tests and investigations have developed experimental data by using single variables, such as steel analysis, tool analysis, tool shapes, and cutting fluids. This information has proved to be a useful guide when combined with industrial experience; for no test method by itself has yet been developed that will include all the characteristics of a specific single or multiple-machining operation.

Bethlehem metallurgical engineers have had long and varied experience and knowledge on the machinability of alloy and carbon steels. They will gladly give you any help you may require in connection with machining problems.

In addition to manufacturing all AISI standard alloy steels, Bethlehem produces other than standard analysis steels, and the full range of carbon grades. Call your nearest Bethlehem sales office for information.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

He kept the crib from rocking

For accurate firing, Titan and its subterranean steelwork crib must be kept in absolute alignment with the earth's center despite natural movements of the crust or nuclear shock. This AMF production engineer's problem was to build the shock absorbers AMF designed for the job. These are massive, pneumatic cylinders constructed of precision-fabricated, precision-fitted steel parts.

Now, it's no particular trick to fit ultra-fine-tolerance parts together if they're of manageable size. But how, as in this case, could he slide a 600-pound, 6-foot-long steel tube, 1¼ feet in diameter, into another tube when the clearance between the two is *less than 3/1,000 of an inch?* How could he maintain alignment to prevent Brinelling or scouring as one slid a full ten feet into the other?

Here's what he did: He put down heavy steel tracks for a series of wheeled carts. He mounted the tubes on carts, adjusted position... and, slid them together.

Single Command Concept

This ingeniously simple but unique horizontal assembly concept is *one more* example of AMF production know-how in action.

AMF people are organized in a single operational unit offering a wide range of engineering and production capabilities. Its purpose: to accept assignments at any stage from concept through development, production, and service training... and to complete them faster...in

- *Ground Support Equipment*
- *Weapon Systems*
- *Undersea Warfare*
- *Radar*
- *Automatic Handling & Processing*
- *Range Instrumentation*
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- *Nuclear Research & Development*

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In engineering and manufacturing AMF has ingenuity you can use...

AMERICAN MACHINE & FOUNDRY COMPANY

February 29, 1960

Aviation Week and Space Technology

Vol. 72, No. 9
Member ABP and ABC

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COVER: Douglas Nike Zeus surface-to-air interceptor missile, fired for the fourth time at White Sands (N. M.) Proving Ground, has had forward fins modified to contain antennae for radar signals (note projection at tip). U.S. Administration has been urged to release $137 million congressional appropriation to Army for Nike Zeus production (AW Feb. 22, p. 33). For other firing photos see pp. 54-55.

PICTURE CREDITS

Cover—Douglas Aircraft; 54, 55—Douglas Aircraft; 56, 57—Ron Appelbe; 61—USAF; 65—Nord (top); Army; 68—USAF; 71, 73, 75—PacAero Engineering Corp.; 81, 83—Military Products Division, American Standard; 87 (top)—General Electric; (bottom)—New York Port Authority; 90—Boeing Airplane Co.; 93—Lockheed, Ryan.

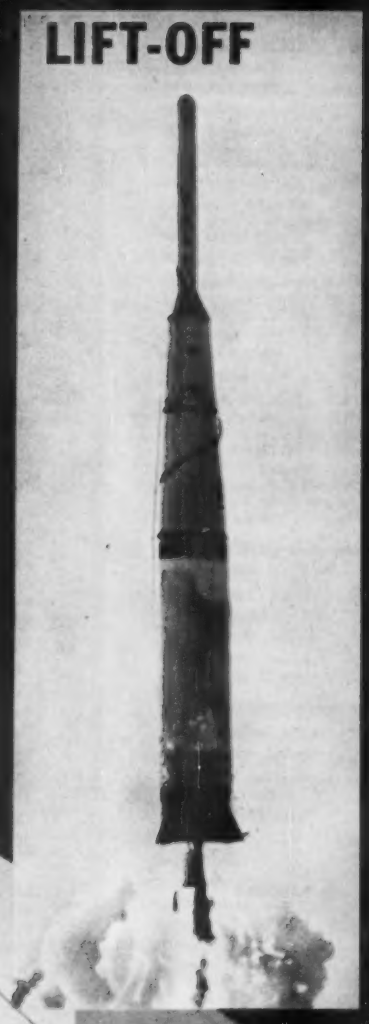
81,294 copies of this issue printed

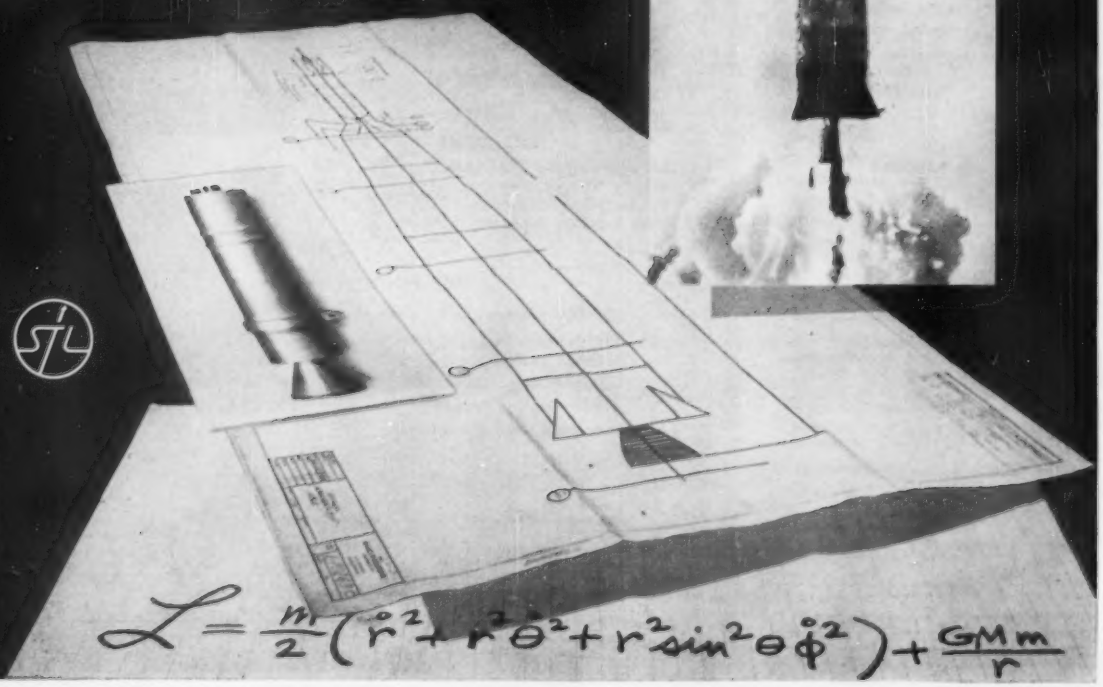
FROM LAGRANGIAN TO LIFT-OFF

Sometimes forgotten during the thundering ascent of a space probe rocket are months of meticulous analysis, engineering and planning. The staff of Space Technology Laboratories is now engaged in a broad program of space research for the Air Force, the National Aeronautics and Space Administration and the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division. For space probe projects STL provides the total concept approach, including preliminary analysis, sub-system development, design, fabrication, testing, launch operations and data evaluation. The total task requires subtle original analysis in many fields as well as sound technical management.

The STL technical staff brings to this space research the talents which have provided system engineering and technical direction since 1954 to the Air Force Ballistic Missile Program. Major missile systems currently in this program are Atlas, Titan, Thor and Minuteman.

The scope of STL's responsibilities offers creative engineers, physicists and mathematicians unusual opportunities to see their ideas tested in working hardware. Inquiries are invited regarding staff openings in the areas of Advanced Systems Analysis, Rocket Propulsion, Space Flight Mechanics, Dynamics, Structural Analysis, and Aerodynamics.





$$\mathcal{L} = \frac{m}{2}\left(\dot{r}^2 + r^2\dot{\theta}^2 + r^2\sin^2\theta\,\dot{\phi}^2\right) + \frac{GMm}{r}$$

Space Technology Laboratories, Inc.

P. O. Box 95004, Los Angeles 45, California

EDITORIAL

South American Swing

We have just returned from a 15,000-mi. swing through South American summer accomplished in less than a day and a half total flying time that provided a remarkable demonstration of the impact jet transports will have on that part of the world and of the effectiveness of the type of person-to-person diplomacy that President Eisenhower so often talks about. The occasion was a pre-inaugural survey of Braniff Airways' jet transport service to Lima, Rio, Sao Paulo and Buenos Aires to begin regular operation in April. Pre-inaugural junkets are a routine hallmark of the airline business, but every once in a while there is a fortunate combination of circumstances that produces an experience that goes far beyond the routine junket. This Braniff expedition led by its dapper president, Charles E. Beard, was one of those notable exceptions.

First, the aircraft was something out of the ordinary. We have flown in both the Boeing 707-120 on domestic service and the 707-320 on international runs, but the 707-227 selected by Braniff is a far different beast. It is a "hot rod" version that retains the smaller airframe and lower gross weight of the domestic 120 but is powered by the larger Pratt & Whitney J75 turbojets of the intercontinental 320. Braniff picked this version primarily to be able to use existing airports along its route without any runway additions, but it also provides a significant speed advantage with its 626 mph. maximum cruise on domestic routes plus a long-range stretch of 3,500 mi. on the international routes. The takeoff and climb performance of the 707-227 at high gross weights was truly startling, particularly on the blistering better than 100 degree Fahrenheit temperatures on the runways at Rio and Asuncion, and the thrust reversers left ample concrete remaining after landings before taxi turnoffs.

Contracting Flight Time

As H. M. "Jack" Horner, chairman of United Aircraft Corp. whose Pratt & Whitney Aircraft Division makes the J75 remarked: "Isn't it fun to fly on an over-powered aircraft for a change?" Braniff pilots Ted Raines and Jack Thomas demonstrated the long-range cruise techniques at 560 mph. airspeed with nonstop legs of 3,276 mi. from Houston to Lima in 6 hr. 20 min. and Asuncion to Panama (3,319 mi.) in 6 hr. 26 min. The entire 15,128-mi. circuit, plus five local demonstration flights carrying nearly 500 South Americans, was made, in the words of Ted Raines, "without one iota of mechanical trouble."

It is obvious from the way they shrink South America's great distances in relative comfort, that the Braniff jets and those of other airlines and manufacturers will play a significant role in binding the cultural and commercial and political destinies of the two hemispheres closer together.

Aside from the impact of its flying equipment, the trip was also notable for its vivid and unique glimpses of this continent from the air and its unusual contacts with its people and leaders on the ground. Some of the air vignettes are unforgettable, the spuming white crescents and spidery white lace of Igacu Falls on the Parana River where Brazil, Paraguay and the Argentine meet. These 17 separate falls plunging over the rock shelf dwarf Niagara and are seldom seen from a jet transport circling 1,500 ft. over the green sea of jungle. The panorama of Brasilia, the new capital of Brazil being hacked from virgin soil of this vast country's interior, also unfolded on another low altitude descent. The wonder of this sight was more in how much already has been completed than in the magnitude of the job still to be done.

Later, in the cool, bright summer of Petropolis, Brazilian President Juscelino Kubitschek, with map unfolded tracing the course of his country's frontier westward, gave meaning to this milestone in his country's expansion of its westward frontier and left little doubt of his determination to merge its regional patterns into an integral nation.

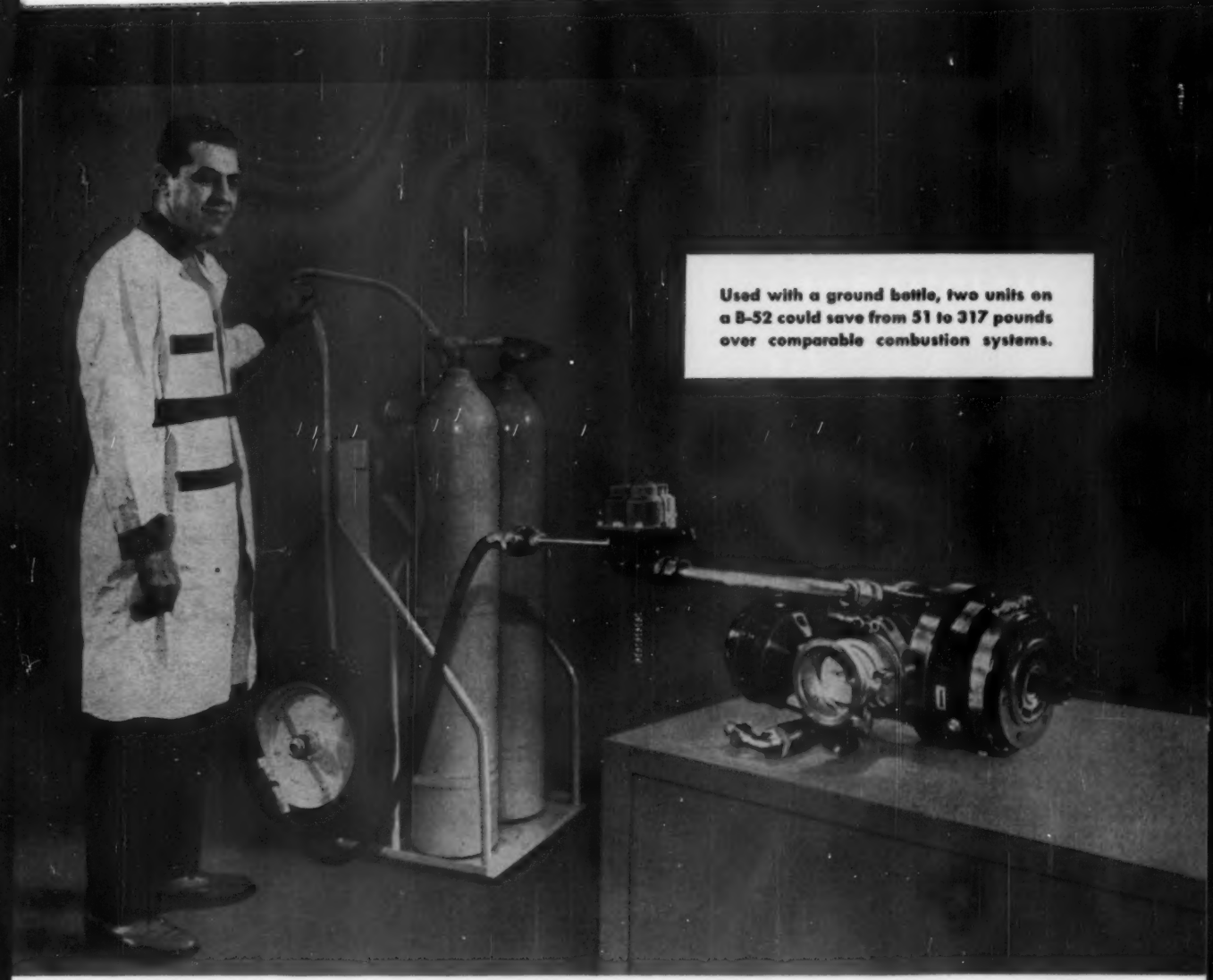
Shirtsleeve Diplomacy

At every stop—in the flowering oasis of Lima set in the arid deserts and mountains of the west coast; in the steaming heat of Rio's matchless beauty; in the park-like atmosphere of the Argentine countryside and the cosmopolitan air of Buenos Aires, the quantity and quality of local residents who turned out to meet this traveling group of journalists, financiers and businessmen was evidence of the sound "sympatico" relations Braniff has cultivated in the areas it serves and the effectiveness of its shirtsleeve diplomacy.

And, nowhere, of course, is the need for expanded modern air transport greater than in the vast expanse of South America, with its paucity of good surface transport and its acute requirement to move its natural resources and raw materials to processing centers and to distribute food and goods to its population.

South America's economic development already has been aided immeasurably by the network of local and U. S. flag airlines that now lace the Southern Hemisphere. More than 90% of the current air travel between North and South America is business and diplomatic. The great North American tourist market has hardly been tapped in this direction. But, just as the 300 mph. piston-powered transport that put Europe only 24 hr. from the United States stimulated the tourist boom in that direction, so will the 500-600 mph. jet transport provide the impetus to open South America to a similar travel flow.

—Robert Hotz



Used with a ground bottle, two units on a B-52 could save from 51 to 317 pounds over comparable combustion systems.

New Hi-Lo starter system permits drastic weight and cost savings

Hamilton Standard's new Hi-Lo starter, designed to operate on either high- or low-pressure air, introduces a tremendous improvement over combustion systems . . . in airborne system weight . . . installation and operational costs . . . and practically every other factor associated with jet engine starter systems.

Basic Design is Simple. The system employs a conventional Hamilton Standard MB-10 pneumatic starter, high- and low-pressure valve, and associated ducting. It is rated to start any version of J-57, J-75 or J-79 engines and operates on air from small ground or air-borne bottles, cross-bleed, and standard MC-1A or MC-11 carts.

Permits Drastic Cost Savings. The simplicity of the Hi-Lo system and its logistics makes possible tremendous savings in installation and operational costs over combustion starter systems.

Gives Twice as Many Starts Before Overhaul. Because the new Hi-Lo system works on cool air, it has a much longer service life than combustion starter systems and actually provides up to twice as many starts before overhaul.

Safest, Most Reliable. Tests show the new Hi-Lo starter provides the highest reliability and safety under any inlet conditions. Even if the regulating valve and blow-out disc fail to operate, and the system were directly subjected to 3500 psi, the wheel would reach approximately half its burst speed—about the same as the free-running speed permissible under actual cross-bleed conditions. In addition, cool-air operation eliminates all risk of fire.

Complete technical data available on request.

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DIVISION OF UNITED AIRCRAFT CORPORATION

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WHO'S WHERE

In the Front Office

Earl D. Hilburn, president and chief executive officer, Burton-Rodgers, Inc., Cincinnati, Ohio, succeeding **Paul C. Rodgers**, who becomes chairman of the executive committee.

Harold F. Lanier, special assistant to the director of electronics, Office of the Director of Defense Research Engineering, Department of Defense, Washington, D. C.

Allen J. O'Brien, director of traffic service, Aerospace Industries Assn., Washington, D. C.

Samuel C. Dunlap, vice president-cargo sales and market development, Trans World Airlines, Inc.

Emmet G. Cameron, group vice president-tube operations, and **Howard R. Patterson**, group vice president-instruments and equipment, Varian Associates, Palo Alto, Calif. Also: **Ralph W. Kane**, vice president and manager of foreign operations.

G. E. Coon, a vice president and manager of sales, services and operations-San Francisco, American Airlines, Inc.

H. Thomas Hallowell, Jr., a director of International Resistance Co., Philadelphia, Pa. Mr. Hallowell is president of Standard Pressed Steel Corp.

Lee D. Webster, executive vice president and a director, Ling-Altec Electronics, Inc., Dallas, Tex., and **James O. Weldon**, a director. Mr. Weldon continues as president of Continental Electronics Manufacturing Co., a subsidiary. Also: **G. Emerson Pray**, a vice president, in charge of the company's national defense program activities, Washington, D. C.

L. J. Keyes, vice president and director of purchases, The Dayton Rubber Co., Dayton, Ohio.

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Robert L. Turner, vice president-customer service, Eastern Air Lines, Inc.

Donald C. Oskin, vice president of executive sales, Chemical Division, Food Machinery and Chemical Corp., New York.

Robert H. Garretson, group vice president-data processing divisions, Consolidated Electrodynamics Corp., Pasadena, Calif.

Warner B. McCarthy, vice president and comptroller, Parker Aircraft Co., Los Angeles, Calif., a division of Parker-Hannifin Corp.

Donald M. Hatch, Jr., a vice president of Dumont Manufacturing Corp. and the parent company, Dutron Corp., San Rafael, Calif.

Honors and Elections

H. Thomas Bean, vice president of Telecomputing Services, Inc., and general manager of the New Mexico Division, has been elected chairman of the Executive Committee of the Holloman Test Directors Council, Air Force Missile Development Center, Holloman AFB, succeeding **Carl Weinert** of Radioplane Division of Northrop Corp.

(Continued on page 96)

INDUSTRY OBSERVER

► Components for Tory II, non-flyable test reactor for Project Pluto, are being assembled at Atomic Energy Commission's Livermore Laboratory for reactor tests at Jackass Flats, Nev. Unit is being built to demonstrate the feasibility of a nuclear ramjet, for which Marquardt Corp. is the associate contractor. Project Slam low-altitude penetration missile is one vehicle scheduled to use the powerplant.

► **Improved performance of the E-series of Atlas ICBMs has been achieved through a 6% increase in engine thrust and a weight reduction program. Series will have a total thrust of more than 402,000 lb. Its avionic gear was cut 50% in weight and 66% in size. In another weight reducing move, skirt around booster engines is made of smooth glass fiber material rather than corrugated metal.**

► Air Force's Midas infrared early warning satellite system has been placed on a master urgency list at the direction of the Office of the Secretary of Defense. Program, however, still has a No. 2 priority status as compared with the No. 1 priority now assigned to the intercontinental ballistic missile programs.

► **National Aeronautics and Space Administration's Thor Able IV deep space probe is tentatively scheduled to be launched from USAF Missile Test Center on Mar. 4. Mar. 8 has been set as the final hold date in event of technical problems.**

► Stauffer Chemical Co. has developed new high energy oxidizers for boron rocket fuels. Oxidizers, based on nitrogen fluoride, leave no boric oxide combustion sludge and are a major reason for renewed Air Force interest in boron fuels (AW Feb. 22, p. 39).

► **Aerojet-General solid rocket engines for the Douglas GAM-78A Sky Bolt air-launched ballistic missile are very similar to the Minuteman engines in concept and state-of-the-art requirements. Air Force believes the Sky Bolt can be put into service in a little more than two years. First flights are expected within a year after the contract signing. This development procedure of staying within the state-of-the-art to achieve a short lead time also was used by the Air Force for North American's Hound Dog air-launched cruise missile.**

► Air scoops will be placed at the rear of production-type Titan ICBMs so that a strong stream of air can be forced through the first-stage engine compartment to prevent base recirculation and heating problems by leaving no air trapped behind the base of the missile. Tests with this configuration have shown that there is no increase in drag due to these scoops.

► **Convair's San Diego Division is establishing a large electronics department which probably will achieve divisional status in a relatively short time.**

► Original single-barrel Reaction Motors XLR-99 rocket engine for North American Aviation's X-15 research aircraft is scheduled to be delivered within the near future. Aircraft probably will be flown by North American test pilot Scott Crossfield only once or twice with this powerplant before the plane is turned over to National Aeronautics and Space Administration at Edwards AFB, Calif.

► **USAF's Ballistic Missile Division has formed a "flying squad" to check on the status of weapon systems under BMD supervision. Atlas and Titan already have been covered, with Minuteman next on the agenda and the booster phase of Dyna-Soar scheduled to follow.**

► Full-scale advanced test silo for the Minuteman solid-propellant ICBM at Cape Canaveral will incorporate a "silo within a silo" construction to overcome effects of the high water table. Launch silo will be surrounded by a large caisson to protect against water seepage.

► **Total Air Force purchase of Douglas C-133 turboprop transports for Military Air Transport Service is now set at 50 planes.**

PHILCO ANNOUNCES

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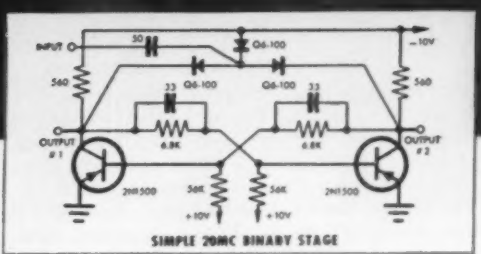
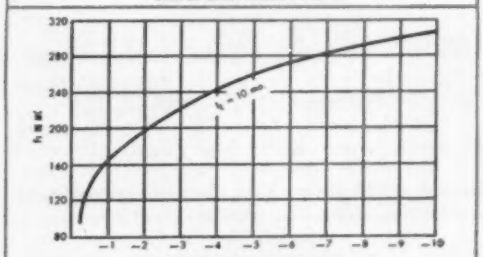
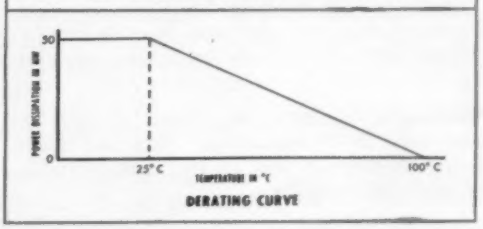


SIMPLE 20MC BINARY STAGE



COLLECTOR VOLTAGE V_{CE} IN VOLTS

TYPICAL GAIN-BANDWIDTH PRODUCT, f_T VS. COLLECTOR VOLTAGE



DERATING CURVE

New MADT* 2N1500 Provides Increased Power Dissipation

Here is another Philco "break-through" in the design and manufacture of high frequency, ultra high-speed switching transistors! This new Micro Alloy Diffused-base Transistor (MADT*) uses cadmium electrodes in place of indium. The higher thermal conductivity of cadmium insures cooler-running junctions for any given power dissipation and provides an extra margin of safety as added assurance of reliable performance.

The new 2N1500 offers the designer these important advantages:

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In electrical characteristics, the 2N1500 is similar to 2N501, which has been thoroughly field-proven in many military and industrial computer applications. It is manufactured on Philco's exclusive fully-automated production lines to the highest standards of uniformity. For complete specifications and applications data, write Dept. **AV-260.**

Max. Ratings		Typical Parameters				
T_{STG} ° C	V_{CB} volts	t_r mμsec	t_s mμsec	t_f mμsec	h_{FE}	$V_{CE}(SAT)$ volts
100	—15	12	7	4	35	—0.1

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TRANSISTOR CENTER U.S.A.

Washington Roundup

U. S. and Britain launched bilateral discussions of airline route problems in a strained atmosphere last week. Negotiations opened in Barbados at a time when the British are still annoyed over Civil Aeronautics Board delay last year in giving British Overseas Airways Corp. Tokyo-U.S. operating authority. British also lack enthusiasm for the discussion because they have all the routes they want from the U.S. for now.

Route patterns are the chief item on the Barbados agenda. State Department is trying to get authority for Trans World Airlines to serve both Frankfurt and Zurich on flights beyond London. Northwest Airlines route to Hong Kong is another major issue. Deadlock seems a strong prospect unless the British are willing to bargain for other concessions in exchange for these routes.

Deadlock over routes could force the negotiations into discussion of the general principles in the present bilateral. State Department wants to avoid getting into these principles because the British bilateral written in Bermuda in 1946 sets the ground rules for all other bilaterals. Changing these Bermuda principles would open all other agreements to change.

Intelligence Confusion

Confusion over intelligence estimates grew last week when it became evident that U. S. officials may not all use the same estimates. Published version of the closed Senate testimony of Joint Chiefs of Staff Chairman Gen. Nathan F. Twining indicates he had not seen the intelligence analysis presented by CIA Director Allen Dulles to the Senate Space and Preparedness Committees. Twining testified that the missile gap was closing.

Democratic critics claim Dulles' data runs counter to Twining's testimony. Sen. Stuart Symington said the Dulles estimates of Soviet ICBM capability give the Soviets a growing lead when compared with former estimates, which conceded Russia a three-to-one ICBM superiority.

Dulles returned to the Senate last week to clear away the confusion. Republicans emerged from the closed hearing satisfied that the confusion stemmed from a revised method of presentation. Democrats were not satisfied with the Dulles explanation.

Whitney Gillilland and Chan Gurney are campaigning hard for James F. Durfee's job as CAB chairman. Board veteran Gurney, a former chairman, and new member Gillilland are both pushing hard for the job Durfee will vacate when the Senate confirms his appointment as a judge on the U. S. Court of Claims.

Greater Effort

Greater U. S. effort to meet the growing Soviet military threat was urged last week on Capitol Hill. Senate subcommittee on National Policy Machinery heard several witnesses, some of them Republicans, say the national military effort is not adequate to meet the Soviet threat. They said more spending is necessary and taxes should be boosted to meet the increased costs.

Higher spending for national security was termed reasonable and necessary. Boston banker and industrialist Robert D. Sprague said it is foolish to contend that higher spending would bankrupt the country. Sprague has served as a White House adviser on military affairs, and he was co-chairman of the group that wrote the Gaither Report. This document reportedly recommended a bigger defense effort, but the White House has kept it under wraps and pigeon-holed it.

Witnesses said a bigger effort would be supported by the public if it understood the real nature of the Soviet threat. Sprague said the job of informing the public is up to the President, and he said the danger is more serious than Eisenhower has indicated. Williams College President James P. Baxter III, another member of the Gaither group, agreed that the public would support an increased effort if it understood the threat.

Quality of information used in reaching national security decisions was also questioned. Sprague said top officials sometimes have inadequate or imperfect information when making these decisions. He blamed some of this information lack on the technique of getting data through briefings.

Wrapup

Airlines and truckers expect to block railroad efforts to change present laws prohibiting the railroads from controlling airlines or trucking firms . . . Rep. Melvin Price (D.-Ill.), chairman of the research and development subcommittee of the Joint Atomic Energy Committee, plans to hold hearings on the status of the aircraft nuclear propulsion program . . . CAB examiner recommends substantial expansion of Central Airlines' route pattern to provide most of the new service required in the Kansas-Oklahoma local service area.

—Washington Staff

Space Power Systems' Gains Reported

Project Orion enters engineering feasibility phase; solar, nuclear units for satellites show progress.

By Evert Clark

Washington—Investigation of the possibility of propelling extremely large space platforms by exploding small nuclear bombs behind them has progressed to the point under Project Orion that engineering feasibility studies are now being made.

Use of nuclear and solar energy to provide auxiliary power for satellites also has shown rapid progress. National Aeronautics and Space Administration has asked industry for proposals on a 3-kilowatt Sunflower I solar collector system for use with Centaur and Saturn vehicles, and is now evaluating proposals for a 30-kilowatt Snap I nuclear generator system, which will be capable of supplying both auxiliary power and useful propulsive power.

Project Orion (AW Nov. 16, p. 128) was initiated by Air Force's Air Research and Development Command in July, 1958, under a $1 million contract with General Atomics Division of General Dynamics Corp. to study the feasibility of development of a rocket propelled by controlled nuclear pulses.

At the end of 1958, Defense Department's Advanced Research Projects Agency authorized another $400,000 to continue the study and to give ARPA more time to determine whether the feasibility warranted further funding in Fiscal 1960. Last Aug. 21, another $1 million was authorized for a year's extension of the program.

Last week, President Eisenhower submitted his second annual report to Congress on the nation's space and aeronautics activities. In addition to discussing progress in a number of civilian agencies, the report covers Defense Department space efforts. With respect to Orion, the report says in part:

"In contrast to earlier effort, the current effort is directed primarily to engineering feasibility studies."

Roy W. Johnson, former head of ARPA, told a Senate Aeronautical and Space Sciences Subcommittee last year that, when Orion was first funded, "it looked screwball; it doesn't look quite as screwball today." He described it as the kind of forward-looking research ARPA was supposed to do, "without a specific hardware implementation in mind," and added:

"This is quite a little trick. First of all, you use bombs, and you use a lot of them. The trick is the creation of a spring mechanism on the platform.

"This is a peculiar thing; it won't work with anything little like a hundred tons. You are going to have to have several thousand tons; it has got to be real big or it won't work, and it has a springing device, against which the shock wave thrusts. Driving the vehicle, of course, the shock must be absorbed sufficiently so that the inhabitants of it are not killed, but so that thrust is still obtained. Some of the very finest scientists in the country have conceived this and are working on it."

Johnson said the system "could maneuver in space and could return the platform to earth."

Snap 8

The NASA-Atomic Energy Commission Snap 8 power system is the forerunner of a family of nuclear auxiliary systems that are expected to play an important part in the Air Force's military satellite programs—possibly in later versions of the Midas infrared early warning satellite or the Samos reconnaissance satellite.

First studies leading to what is now called the Snap program were initiated by AEC for USAF after strategic reconnaissance satellite studies from 1946 to 1954 established that the duration, reliability and high power requirements could only be met by nuclear power sources.

Lockheed Aircraft Corp., prime contractor for Midas and Samos, also is a member of a government-industry Snap Coordination Group which reviews management guidance of the Snap program. Other members are representatives of the Snap Project Section of AEC's Aircraft Nuclear Propulsion Office; Air Force Ballistic Missile Division; the Martin Co., which is developing radioisotope units, and Atomics International Division of North American Aviation, Inc., which is developing reactor units.

Snap 8 employs the reactor concept. The reactor, which will be handled by AEC, is an extension of the Snap 2 reactor concept. It will weigh approximately 250 lb. Associated conversion equipment, for which NASA is negotiating a contract, will bring total weight to about 900 lb. exclusive of shielding.

Other AEC Work

AEC also is working on:

• **Snap 10.** Completely static, reactor-powered thermoelectric generator producing 300 watts of electricity has been designed and construction is being negotiated with industry. Disk-shaped fuel elements of the Snap 2 material are being manufactured. Nuclear test is planned for the quarter beginning July 1 in a new environmental test facility at AEC's Los Angeles County site. Static conversion techniques are said to provide only small amounts of power now, but to be highly reliable because they have no moving parts.

• **Snap 2.** Tested at design power of 50-kilowatts and outlet temperature of

Titan Range Test

Cape Canaveral, Fla.—Air Force-Martin Titan flew 5,000 mi. down the Atlantic Missile Range last week in its first full ICBM-range test. Data capsule ejected from the prototype Avco ablative operational nose cone was recovered near Ascension Island. Titan-G was guided by the Bell Telephone Laboratories command guidance system which will be used in early operational Titans.

Canadian Satellite

Ottawa—Canada's 200 lb. ionosphere sounder satellite will be launched into a 700 mi. polar orbit late next year by a Thor-Delta vehicle. It will use radar in a sweep frequency sounding technique to probe the top side of the ionosphere, and it also will make galactic noise studies.

Data on radar signals reflected off the top of the ionosphere will be transmitted to four receiving stations in Canada and to other ground facilities furnished by National Aeronautics and Space Administration. Spherical satellite will have two 30 ft. antennas that will extend in orbit. Satellite will be powered by solar batteries and is expected to broadcast for one year.

Canadian Defense Research Telecommunications Establishment will build four satellites. One will be used for ground tests, and the second will be a prototype vehicle to be tested with a NASA sounding rocket. Remaining two satellites will be delivered to the Pacific Missile Range launch site.

1,200F last Nov. 9, this system is to get its first integrated reactor and power conversion system tests in the first or second quarter of Fiscal 1961. Over-all weight exclusive of shielding is expected to be about 500 lb. Small zirconium hydride moderated reactor, which weighs about 220 lb., is homogeneously fueled with 3 kilograms of uranium 235.

• **Snap 1A.** An extension of the 2.5-watt Snap 3 concept, this radioisotope-decay thermoelectric system would produce 125-watts. It is being developed as a ground demonstration unit only. An electrically-heated unit will be completed this year and will enter a comprehensive test program.

Defense Issues Debated in Congress

By Katherine Johnsen

Washington—President Eisenhower's televised, nation-wide assurances that the U.S. defense program is "ample for today" and for "the needs of tomorrow" (see box p. 28) spurred a running debate in Congress last week with Sen. Stuart Symington (D.-Mo.) as the leading challenger.

Symington responded to the President's statements by repeating on the Senate floor his charge that the missile gap between the U.S. and Russia is widening, not narrowing. "My statement stands—the American people are being misled," he declared. "The American people are being told one thing in public statements by members of this Administration; and the U.S. Senate is being told a vastly different story in secret or executive hearings . . .

"Therefore, this Administration should publish now what it is estimated the Soviets will be capable of launching against this country, compared with our like capability—in ratios or percentages—for mid-1960, mid-1961, and mid-1962."

While Symington called for "the truth" and "the facts," Republican congressional leaders emphasized that "judgment" is an important element in determining the level and composition of defense forces—and unearthed history in efforts to cast doubts on Symington's past and present judgments on defense matters.

Sen. Everett Dirksen (R.-Ill.), minority leader charged in a floor speech that Symington in previous years has been an advocate of economy first, defense requirements second. Dirksen gave these two citations:

• **In a speech on Mar. 14, 1952,** to the Yale Alumni Assn. in New York, Symington, according to Dirksen, stated: "Perhaps the Politboro will now rely on their silent weapons, such guns as crippling taxes, unprecedented spending, inflationary tendencies and the consequent effects on . . . personal incentive and corporate initiative . . . I have great respect for most of our military leaders, but as sure as the sun is coming up tomorrow, if military appropriation requests are not checked as carefully as all other appropriation requests, this armament program can only end in national bankruptcy."

• **Earlier, on Jan. 27, 1949,** Dirksen said Symington, while serving as Secretary of the Air Force, told the House Armed Services Committee:

"What the military and Air Force consider is essential to security . . . is not paramount, as I see it. Anybody against us can win in two ways. The first would be in battle and the second would be by forcing us to spend more money than the country could afford, getting into deficit spending."

Republicans also noted that Democrats now publicly pronouncing 1961-63 as an era of military peril for the U.S. had also pronounced 1954 and 1960 as eras of military peril for the country.

Afterward, Symington declared: "It may be that my estimate of $2.5 billion to $3 billion may be wrong and that Gov. (Nelson) Rockefeller was right in recommending that in the next budget, we should include $9 billion more" than the $41 billion proposed by the Administration.

Meanwhile, Robert E. Lovett, a Re-

Lanphier Resigns in Defense Policy Protest

San Diego—Thomas G. Lanphier, Jr., vice president and assistant to the president of the Convair Division of General Dynamics Corp., resigned last week in order to freely challenge the Administration's defense policies. Effective date of the resignation is Mar. 15.

Lanphier, an advocate of an accelerated ballistic missile program and an airborne alert for the Strategic Air Command, said in his resignation statement:

"As I understand democracy, an American who sincerely believes the nation is in danger, must in good conscience say so. In this vein, I feel strongly about what I believe to be the Administration's underestimation of the Soviet military threat for the next three years. And I feel equally strongly about its concurrent overestimation of the strength and survivability of our own defenses during that same period.

"While I realize that many don't agree with me, I feel we are well into, if not already past, that critical moment when our nation can still do something about maintaining a position of material strength from which to continue to work effectively for some measure of peace and freedom for ourselves and our children.

"This winter may be our last chance to so act. Next winter could well be too late.

"As an individual, I want to continue to exercise my rights and privileges as an American citizen to criticize my government, particularly in the area of defense where I feel I have some experience as basis for valid comment.

"I want to do this without being factored as a 'missile salesman' and without implying endorsement of my views by the organization which employs me.

"Therefore, as of Mar. 15, I am leaving Convair, a company of men and women with whom I have for the past nine years been proud to be associated in the significant contributions they have made and are making to the national defense."

Following Lanphier's announcement, General Dynamics Board Chairman Frank Pace issued the following statement:

"Tom Lanphier has rendered exceptional service, both to Convair and General Dynamics. I accept his decision to leave with the deepest regret."

J. W. Naish, Convair president, said:

"It is with deep regret, both personal and corporate, that I accept Mr. Lanphier's resignation. During his long association with Convair, he was intimately associated with and made outstanding contributions to successful development of the Atlas, F-102, F-106 and B-58 Hustler programs."

Lanphier, chairman of the board and former president of the National Aeronautics Assn., flew more than 100 combat missions in the South Pacific and another 12 in the European theater as an Air Force pilot in World War II, destroying 7 Japanese planes in air-to-air combat and 10 others on the ground. He holds the Navy Cross, Silver Star with cluster, Flying Cross with cluster and the Air Medal with five clusters.

A former president of the Air Force Assn., Lanphier served as Special Assistant to the Secretary of the Air Force for Research and Development from December, 1949, to May, 1950. He was appointed a member of the Air Force Scientific Advisory Board in 1950.

publican who served as Secretary of Defense in the Truman Administration, gave his views on improving the national defense policy machinery to a Government Operations Subcommittee, headed by Sen. Henry M. Jackson (D.-Wash.).

One of Lovett's main recommendations: that civilian defense officials, as well as the military, should be "nonpolitical and non-partisan."

Lovett noted that during his secretaryship, as well as that of the late Gen. George Marshall, Defense officials were barred from making speeches at political gatherings.

"The practical consideration of representing the needs of the nation as a whole before Congress, and the nonpolitical operation of the draft law, ought to make the desirability of nonpartisanship in the military structure abundantly apparent. The only thing more dangerous than an external enemy is a group of home-grown military sycophants."

Lovett warned against the "civilian businessman who suddenly becomes an expert on military strategy" and the military man who "magically becomes an expert" in production or other fields where he has had no experience.

He urged a full-partnership between the State and Defense Departments and recommended that these two departments participate in setting the budget guide lines for national security programs.

"National political policy includes foreign policy and defense policy . . . and simply cannot be fragmentized," Lovett said. He also emphasized "the importance of having the budgetary goals determined from the outset by a great concern for a system of priority of national need and not have them too greatly influenced by the officials of the Bureau of the Budget itself."

President Scores Defense Critics

Washington—President Eisenhower strongly defended Administration defense policies against all critics during his final press conference before leaving last week on a tour of four Latin American capitals and during a nation-wide radio-television address on the eve of his departure.

Here's the question that led to the President's press conference defense of his policies and his reply:

• Charles E. Shutt, Telenews—"Mr. President, two of the many charges that your defense critics have made against you and your Administration are that the Administration has been complacent in advising the people of the danger we face in world affairs. The other is that economy may stand in the way of developing some weapon or a series of weapons we may need.

"Sir, do you believe that the Administration has misled the American people in any way, or that any money has been withheld from any weapon we might need?"

• The President—"If anybody—anybody—believes that I have deliberately misled the American people, I'd like to tell him to his face what I think about him. This is a charge that I think is despicable, and I have never made it against anyone in the world, and I wouldn't as long—unless he were in a bar of justice somewhere to be tried for something that was intolerable.

"Now, I would like to see somebody—people like yourselves—take the whole history of our defense organization from 1945 until this minute and see what has been done. Frankly, this nation unilaterally disarmed, and it wasn't until the danger or the great surprise attack in Korea that came about that we started in the other direction. And in almost every field of development we were behind. And we have changed our—we had to change our policy at that time, back in 1950, and from that time on, we sought one thing—adequacy, adequacy in our power to deter and defend ourselves, and particularly to help these areas which are so exposed to the menace of Communist imperialism so that they may give reasonable, a reasonable defense of themselves and their lives and their rights, while their allies could come to their assistance.

"This is what I believe we've been trying to do with all our might, and I get tired of saying that defense is to be made an excuse for wasting dollars. I don't believe we should pay one cent for defense more than we have to.

"But I do say this: Our defense is not only strong, it is awesome, and it is respected elsewhere."

In his radio-television address, the President once again came to the defense of his military and budget policies. He said:

". . . For the first five years following World War II, we in the United States, hopeful of a global and durable peace, pursued a policy of virtual disarmament.

"But the blockade of Berlin, the military weakness of our European friends living face to face with the Communist menace, and finally the Korean War—together with arrogant threats against other peaceful nations—belatedly made it clear to us that only under an umbrella of military strength could free nations hope to make progress toward an enduring and just peace.

"World uneasiness rose to the point of alarm.

"Since then, our nation has developed great arsenals of powerful weapons to sustain the peace. We have created a great deterrent strength—so powerful as to command and to justify the respect of knowledgeable and unbiased observers here at home and abroad.

"Our many hundreds of Air Force bombers deployed the world over—each capable of unleashing a frightful destruction—constitute a force far superior to any other, in numbers, in quality and in strategic location of bases.

"We have, in addition, a powerful nuclear force in our aircraft carriers and in our host of widely deployed tactical aircraft. Adding constantly to these forces are advanced types of missiles steadily augmenting the armaments of all ground and other military units.

"As for longer-range ballistic missiles, from a standing start only five years ago, we have literally leaped forward in accomplishments no less than remarkable.

"Our Atlas missile, already amazingly accurate, became operational last year. Missiles of intermediate range are in forward bases. The first Polaris missile submarine—an almost invulnerable weapon—will soon be at sea. New generations of long-range missiles are under urgent development.

"Collectively, this is a force not unduly dependent upon any one weapon or any one service, not subject to elimination by sudden attack, buttressed by an industrial system unmatched on this earth and unhesitatingly supported by a vigorous people determined to remain free. Strategically, that force is far better situated than any force that could be brought to bear against us.

"As we have strengthened these defenses, we have helped to bolster our own and free world security by assisting in arming 42 other nations—our associates in the defense of the free world.

"Our part in this indispensable effort is our mutual security program. It makes possible a forward strategy of defense for the greater security of all, including our neighbors to the south.

"I am certain that our Latin American neighbors, as well as you here at home, understand the significance of all these facts.

"We have forged a trustworthy shield of peace—an indestructible force of incalculable power, ample for today and constantly developing to meet the needs of tomorrow.

"Today, in the presence of continuous threat, all of us can stand resolute and unafraid—confident in America's might as an anchor of free world security. . . ."

House Approves Project Mercury Funds

By Craig Lewis

Washington—House approved a $23 million supplemental appropriation last week which National Aeronautics and Space Administration had requested to keep its Project Mercury schedule from slipping.

The full supplemental request was passed without change, but the House followed its appropriations committee recommendations on another NASA request and cut a proposal for new personnel from 250 to 175 positions.

If the Senate approves the request, the supplemental appropriation will be added to the $500 million appropriated last year for Fiscal 1960. Of the $23 million, $12.2 million is for research and development work on the Project Mercury capsule, $6.8 million is for construction and equipment for the Mercury tracking network and $4 million is for modification of Atlas Pad 12 at Atlantic Missile Range to accommodate the Agena-B upper stage.

Supporting the request before an appropriations subcommittee, NASA Administrator T. Keith Glennan said the supplemental is needed to maintain the scheduled pace in the Mercury program. "We find ourselves in this situation: for instance, if we do not have the means to push forward urgently with this network problem, we probably slip these schedules three to four months, and the funding for the capsule rearrangements and rework get into the same general ballpark," he said. "This is an attempt to keep to a schedule which has slipped as much as we can allow it to slip."

The $12.2 million research and development part of the supplemental is scheduled to go to McDonnell Aircraft Corp. for contractor overruns, changes in capsule design and construction and for added capsule requirements. Design changes and additional requirements have been added to the capsule program since it was originally laid out early last year.

Commenting on these changes, NASA Deputy Administrator Hugh L. Dryden said that, if the project were carried out in the normal sequence, "you would not fly a man for five or six years. If you are going to fly him soon, you have to start building a capsule the way you think it should be now, and, as the tests proceed, you have to go back and alter the capsules that are in the process of construction."

Glennan told the subcommittee of a number of changes made in the capsule, including installation of an ejection system for the side hatch rather than bolting the hatch on the capsule. A large window was added to replace the small porthole originally planned. Little Joe tests have shown that the escape rocket blast has the effect of sandblasting this window at high altitudes, and NASA is now trying to solve the problem and maintain visibility.

Supplemental funds also would cover development of an alternate reaction control system which may replace the present system if it proves more efficient, and instrumentation for a more powerful communications system for the pilot. Also covered is a rate damping feature in the manual control system to damp capsule oscillation.

NASA also said it needs additional flight monitoring and telemetry equipment at the Atlantic Missile Range for the manned Redstone flights planned late this year. The agency has ordered additional capsules, bringing the total to 20, because it is more economical to buy new capsules than to rebuild them after test flights.

Capsule Hardware

During Fiscal 1961, spending for qualification of capsule hardware will be largely completed, and the tracking network will become operational. In this same period, expense for tracking and recovery operations will grow. Systems for controlling the capsule landing point also will be under study during this period, including wind tunnel testing of controllable re-entry vehicle models and use of flight simulators to evaluate pilot ability to fly such vehicles.

With the $12.2 million supplemental request and the $35 million scheduled for the McDonnell capsule in Fiscal 1961, total capsule costs mount to about $105 million. This capsule cost is considerably higher than original estimates, as are the costs of such other elements as the tracking network. Total program costs have grown from an original estimate of $200 million to about $350 million.

Funds for the Mercury network in the supplemental would be used to improve facilities in the control center at the Atlantic Missile Range to cut the time in which AMR will be able to decide to abort the Mercury mission if the capsule is not going into orbit properly. Communications would be improved at the 18 tracking sites, and new facilities would be installed at Navy's Pacific Missile Range and Kauai Island, Hawaii, tracking sites. These two new stations would replace two Air Force stations which USAF wants to keep free for Discoverer launch operations. Western Electric is the tracking net prime contractor.

Bermuda station is the only permanent site being built as a result of the Mercury program. Other new stations are van-mounted or shipboard installations that can be shifted after the program is completed. Bermuda station is important because of the need for fast, accurate and complete data in the early phase of the flight. Bermuda station will have S-band and C-band radar, as well as equipment for communication with the pilot.

The $4 million supplemental request for AMR Pad 12 includes modifications to provide an umbilical tower high enough to service the Agena-B upper stage, reposition work platforms on the service tower to match the Agena configuration and to change the ramp to facilitate loading of the Agena stage on the Atlas.

Air Force made Pad 12 available to NASA, and the agency decided it would be cheaper to convert this Atlas pad for Agena use than to build a new pad. Some operational flexibility is expected between use of Pad 12 and Pad 36, which is scheduled for Centaur use.

While dealing with the supplemental request, the appropriations committee also considered a request to add 250 positions to the current personnel ceiling of 9,836. NASA plans to cover expenses of the extra personnel within its present budget. The agency wants to hire 100 employes for its Huntsville Ala., facility to plan the transfer of elements of Army Ballistic Missile Agency and to hire 150 additional employes for its headquarters staff.

Appropriations committee cut the headquarters personnel request to 75 and approved the 100 extra employes for Huntsville, and the House approved the recommendation. The committee warned NASA that its headquarters staff is "getting top-heavy" and "loaded down with too many scientists who are doing administrative work rather than productive research." The House group also noted that 109 of the authorized 260 supergrade positions have been allocated to headquarters, many of them for administrative work. The committee said it expects any such fulfilled positions to be reserved for the scientific and engineering staffs at Huntsville and other research laboratories.

In earlier testimony before the House Space Committee, NASA officials outlined a pattern of launchings over the next few years. Flight testing for the Mercury program will increase in volume and scope beginning this summer with Redstone and Atlas boosters, and sounding rocket activity will increase to the level of 100-120 launches a year.

Space Technology

Space Lag Blamed on Conservative Effort

By Ford Eastman

Washington—Lack of motivation, funds or clearly defined policies were described last week as the major weaknesses impeding the U.S. space program by top space technology experts appearing before the House Committee on Science and Astronautics.

The present national program is conservative at best, they told the committee, adding that unless the importance of space is realized and bolder steps taken immediately, the U.S. may not be capable of recapturing its technological lead. Witnesses included:

• **Dr. William H. Pickering,** director of California Institute of Technology's Jet Propulsion Laboratory operated for the National Aeronautics and Space Administration. Dr. Pickering said: "The real problem results from our confusion and indecision as to what the exploration of space really means, and what is the motivation for the exploration of space . . . If we can really understand the motivation and the reasons for the space program and agree upon this, then it is easy to establish the priorities and support necessary for the program." Pickering added that the 10-year space program planned by the National Aeronautics and Space Administration "represents bold and imaginative thinking based on solid engineering analysis" but that efforts to accomplish the objectives should be doubled to shorten the time span by several years.

• **Dr. Howard S. Seifert,** of Space Technology Laboratories and president of the American Rocket Society. Dr. Seifert said that a majority of the ARS Board of directors, polled for their views on the adequacy of the U.S. space program, "seemed to feel that three aspects of America's space program need discussion and examination—its planning, funding and its technical goals." He called for a clearly defined national policy on space, funding geared to a series of long-range purposes based on a realistic appraisal of national resources and more emphasis upon projects requiring long lead time.

• **Dr. George R. Arthur,** president of the American Astronautical Society. Dr. Arthur told the committee: "It appears the U.S. program is a conservative one as there are many areas where we could be bolder, specifically in application areas such as the meteorological satellites, communication satellites and probes to Venus and the sun. We must remember that programs of this type have tremendous potential, and we would be in favor of accelerating this type of program independently of any Russian accomplishments."

• **Dr. H. Guyford Stever,** professor of aeronautical engineering at the Massachusetts Institute of Technology, who represented the Institute of the Aeronautical Sciences. Dr. Stever said: "We believe strongly in the necessity and in the urgency of extending the boundaries of human knowledge of the universe in which we live. New techniques developed in the past decade have opened up possibilities for exploration and for exploitation of space at speeds and altitudes ranging from zero to infinity. It is essential that we take full advantage of these capabilities both for the betterment of our people and for the security of our country." Dr Stever said that the IAS as an organization does not take a stand on the questions of funding of programs, priorities or national objectives since such things are outside its charter.

Dr. Pickering pointed out that in 1955 the U.S. was recognized everywhere as the world leader in "technology, in know-how, in daring and imaginative engineering projects" but that within five years the situation has become "dramatically reversed."

'Space Primer'

Pickering recalled that, after the first Soviet satellite in October, 1957, the President's committee on science drafted a space primer in which a "calm assessment was made of the reasons for a space program," listing scientific, commercial, military and human objectives. Reflecting views he had expressed earlier at a Washington meeting of the American Rocket Society (AW Nov. 23, p. 26), Pickering added:

"With the hindsight that comes two years after the event, it would seem to me that the space primer omitted the most important immediate objective; that is, to equal or exceed the achievements of Russia in space. In other words, we should frankly admit what the rest of the world knows—that we are indeed in a race with the USSR in space. One can come to no other conclusion."

Pointing out that NASA was organized only 10 months after Sputnik I, Pickering said: "Indeed it can be argued that the size and magnitude of the U.S. civilian space effort since then has been greatly influenced by the Russian program. I feel that, if we really emphasize the importance of the race with Russia, the space program would move at a faster and more steady pace."

Military vs. Civil Space

Pickering, referring to the current debate over military vs. civilian space projects and their relationship to the over-all ballistic missile program, said "the missile program is developing a weapon to be used in war or to prevent war; and our space program is a cold-war weapon." He added:

". . . if this key point could be accepted by the scientists on the one hand and the military on the other, then we as a nation could establish a space program which would quickly re-establish our technological position in the world. At the same time, the scientists would be able to conduct the scientific exploration, and the military would be in a position to exploit possible military applications of space."

Dr. Pickering said there is an increasing tendency for military applications to dominate the space picture, adding that this is unfortunate from the stand-

Single Space Agency Proposal

Philadelphia—Hilliard W. Paige, general manager of General Electric's Missile and Space Vehicle Department, called last week for combining the civilian and military space programs into a single agency under military control.

Paige, speaking before the Philadelphia Chapter, National Society of Engineers, said that, if present trends continue, the U.S. will lose its over-all scientific leadership to the Soviet Union within 10 years and may lose its industrial leadership soon afterward. He suggested the following framework for the U.S. space program:

- **"Immediately combine existing space and missile programs under a single agency. History, experience, and common sense tell us that a fragmented program is self-defeating.**
- **"Increase significantly the funds available to that agency. I have been told that the figure for Fiscal 1961 might well be $45 billion to $50 billion for defense, space, atomic energy and science.**
- **"Raise the priority given to space exploration as against missile development. The contest for space will be increasing in intensity long after the missile race has been forgotten.**
- **"Place the operational end of this program unequivocally under military, not civilian, control." Paige said the exploration of new frontiers has historically been the province of the military and that there is an "abundance" of military leadership available to head the combined agency.**

point of the U. S. international position and so far as support of the total space program is concerned.

Both programs, he said, must compete for scarce manpower, facilities and dollars and, because of the high cost, unnecessary duplication and competition should be avoided. The answer, he said, is to require a "truly unified national space program" with greater coordination and cooperation between NASA and the Defense Department.

Dr. Pickering told the committee that the unified program responsibility should be given to NASA for fundamental research, development and exploration, with a military applications group looking for ways to exploit military possibilities resulting from the experiments.

A different view was expressed earlier by Maj. Gen. John B. Medaris (USA, ret.), former commander of the Army Ordnance Missile Command.

Medaris called for a unified command of the national space program within the Defense Department. He said each service should be fully represented within, and dependent upon, the command and feel the compulsion to support it. As a result, he said, the availability of various supporting elements of the services to back the effort would be assured.

"In order to assure adequate attention to the scientific side of space exploration," Medaris said, "the scientific community should be represented at the command level, thus aligning individual and national objectives."

Dr. Seifert told the committee that one of the weaknesses in planning the space program lies in the absence of a "clearly defined national policy on space. One day space is regarded as the key to the nation's survival, the next as an expensive gamble which is largely irrelevant to our national destinies."

Planning and funding of space projects are affected critically by "these oscillations of opinion," he said, "often in a damaging fashion. We as a nation should decide, first of all, how important we feel space to be and then be prepared to act upon the consequences of a decision."

Funding, Dr. Seifert said, has been "conspicuously deficient in the field of basic research. More funds are badly needed in this area. Furthermore a short-term funding structure is incongruous with the nature of fundamental research. The length of the funding should be determined by the nature of the project, not by arbitrary fiscal dates," he suggested.

As for technical goals, Seifert said emphasis should be given first to high performance vehicles and powerplants which require 5-to-10 years' lead time, without which major exploratory work cannot be carried out. These, he said, include 1 million lb. recoverable boosters, medium scale rockets using new energetic propellants, nuclear rockets of 100,000 lb. thrust and up and electrical propulsion rockets of about 1/10th lb. thrust.

Dr. Arthur said that while the U. S. earth satellite exploration program appears well in hand, a more rapid rate of development of the planetary probe program appears to be warranted.

He said that, while some advance planning is in progress at present in the manned satellite field, "it is felt that the lack of strong support for a substantial follow-on program to Project Mercury is a definite gap in our present space program."

At the same time, Dr. Arthur told the committee that all agencies engaged in space exploration should make a better effort to keep the public informed of the implications and serious problems of space technology. "In addition," he said, "the impact of a bigger and bolder program in space on the public in terms of the financial support and technical manpower that must be given to these programs should be emphasized now."

Dr. Arthur did not take a stand as to where control of the space program should be placed—either all civilian, all military or any of the other plans suggested. He added, however, that "any of the several plans for achieving space flight and advancing space technology can be realized, provided we have strong leadership at the top. This is our biggest problem in this regard."

Durfee Cites Explosion Evidence

Washington—Civil Aeronautics Board said last week it has found evidence that dynamite touched off by a dry cell battery exploded inside the fuselage of the National Airlines DC-6B which crashed Jan. 6 near Bolivia, N. C. (AW Jan. 11, p. 39; Jan. 18, p. 37).

Testifying before the Senate Aviation Subcommittee last week, CAB Chairman James R. Durfee said the dynamite explosion occurred in the vicinity of the seat occupied by Julian A. Frank, a passenger who had insured himself for more than $1 million.

Durfee emphasized "that the statement I have here today represents an interim report to this committee . . . and in no means should be taken as a determination of probable cause . . ."

Durfee told the committee that small pieces of steel wire, cloth fiber and "black deposits," later found to be manganese dioxide used in dry cell batteries, were found deeply imbedded in Frank's body. Manganese dioxide also was found on other pieces of the interior of the aircraft, and a number of foreign objects were found imbedded in the aircraft's carpeting.

Durfee noted that Frank's body and several large fuselage and cabin interior fragments were found 20 mi. from the location of the main structure of the airliner. Frank's body was not found until three days after the accident.

The chairman said the DC-6B has been reconstructed at Wilmington, N. C., and most of the pieces of wreckage have been photographed where they fell. The airliner's four engines have been disassembled by CAB investigators. Examination of the engines thus far has disclosed "no malfunction that could have caused the accident, and, at the same time, it was determined that there had been no in-flight propeller failure," Durfee said.

The CAB chairman said there had been a "catastrophic" failure of the DC-6B's outer skin toward the right front side and that the skin and cabin fragments found near Frank's body at Kure Beach, N. C., corresponded with those parts located in the cabin wall near the point where Frank is believed to have been seated.

Midas Detection System

Washington—Midas infrared early warning satellite uses a selective system that will record only heat phenomena-altitude combinations that are common to incoming warheads, incoming meteors and a rocket with its engines burning at extreme altitudes.

Operational network probably would include four or six in a common circular polar orbit at an altitude of approximately 200 mi. Infrared system in each satellite might be masked differently so a range of heat-altitude combinations would be covered.

Midas was tentatively scheduled for its first test launching late last week from Cape Canaveral, Fla., with Convair Atlas 29-D topped by a Lockheed Agena. Satellite itself is the Agena with the infrared instrumentation in the nose. Goal was to be a non-polar orbit with a perigee of about 150 mi. and apogee of about 250 mi. Attempt at a circular orbit will wait for a later shot.

Launch angle was to be such that the satellite would not cover Russian territory. If infrared units worked correctly, Midas was to attempt to monitor missile flights from Cape Canaveral and from Vandenberg AFB, Calif., store the information and relay it on command.

Agena stage is earth-oriented in operation, and masking of the infrared detectors eliminates data from static engine tests on the ground and short-range, low-level missile flights.

Missiles Dominate Construction Budget

Washington—More than half the $676 million in new construction projects requested by Air Force for Fiscal 1961 will go into the building of operational missile site facilities.

USAF Secretary Dudley C. Sharp told the House Armed Services Committee that $342 million is being requested for missile facilities, of which $281 million is scheduled for the dispersal and hardening of Atlas, Titan and Minuteman intercontinental ballistic missile sites. Here is a breakdown of the Air Force Fiscal 1961 construction authorization requests:

- **Strategic forces**—$378.8 million, or 56% of the total.
- **Air defense**—$127.8 million, 18.9% of the total.
- **Air defense**—$127.8 million, 18.9% of the total.
- **Tactical forces**—$24.4 million, 3.6% of the total.
- **Military air transport**—$6.6 million, 1% of the total.
- **General support**—$120.7 million, 17.9% of the total.
- **Unforeseen construction**—$17.5 million, 2.6% of the total.

Additional Funds

While funds for new projects are set at $676 million, Sharp said the Air Force also will ask Congress for other authorizations that would bring the total to $738 million. Additional funds would include $50 million for increases in prior authorizations, $4.5 million for the Air Force Reserve and $7.2 million for the Air National Guard.

The $50 million increase in prior authorizations would provide additional construction needed in connection with the increase in Atlas squadrons from nine to 13, the Air Force said.

Fiscal 1961 requests will provide for construction projects at 109 major installations, of which 77 will be in the 50 states at a cost of $229.5 million and 32 outside the U.S. at a cost of $105 million.

Of the $105 million to be spent outside the U.S., $1 million is scheduled for U.S. territories and possessions, $30 million for projects in Canada which directly contribute to joint continental defense and the remaining $74 million for projects in foreign countries outside North America.

Here is the construction status of the three ICBMs as outlined by the Air Force:

- **Atlas**—Construction has been completed or is under way on seven of the first nine squadrons. Work on the other two has been advertised for bids. The additional four are now under design and scheduled for contract this summer. New projects for the Atlas provide for minor additional facilities such as test and training facilities and short lead time technical support items for the previously programed operational squadron sites. This, along with prior years' authorization for the remaining four, will substantially complete the construction under present program objectives.
- **Titan**—Major portion of the amount requested will provide facilities for four additional operational squadrons, bringing the total to 10. Authorization for the remaining four, 11 through 14, will be requested next year, the Air Force said, although this year's request will provide funds for advance site preparation for these four. Construction has begun on three of the first six squadron sites, and two more are under contract with work scheduled to get under way shortly. The first six squadrons employ an elevator in each of the 155-ft.-deep underground silos to lift the missile to an above-ground firing position. Seventh and subsequent squadrons will be capable of firing directly from the silo.
- **Minuteman**—Fiscal 1961 construction program includes authorization to build facilities for the first two operational squadrons plus additional silos for test and training and advance site preparation for squadrons which USAF hopes will be approved under the Fiscal 1962 program. The Minuteman also will be dispersed in underground silos and will be capable of launching from the silos.

Fiscal 1961 Air Force construction authorization requested for other projects includes:

Department of the Air Force
Fiscal Military Construction Authorization

(in millions)

		% of total
STRATEGIC FORCES	($378.8)	(56.0)
Ballistic Missiles	281.2	41.6
Satellite Programs	17.1	2.5
Bomber Facilities	47.3	7.0
Tanker Facilities	2.5	0.4
Strategic Support	30.7	4.5
AIR DEFENSE	(127.8)	(18.9)
Defense Missiles	26.0	3.8
Interceptor Facilities	15.2	2.3
Aircraft Control & Warning	37.7	5.6
SAGE	35.1	5.2
Air Defense Support	13.8	2.0
TACTICAL FORCES	(24.4)	(3.6)
Tactical Missiles	17.9	2.6
Tactical Aircraft	3.2	0.5
Tactical Support	3.3	0.5
MILITARY AIR TRANSPORT	(6.6)	(1.0)
Transport Aircraft	0.7	0.1
Photo Mapping & Charting	3.7	0.6
MATS Support	2.2	0.3
GENERAL SUPPORT	(120.7)	(17.9)
Research, Development & Test	26.9	4.0
Training & Education	22.7	3.4
Depot Operations	10.7	1.6
Overseas Theater Forces	51.6	7.6
HQ USAF Support	3.8	0.6
Special Facilities	5.0	0.7
UNFORESEEN CONSTRUCTION	(17.5)	(2.6)
TOTAL	$675.8	100%

• **Satellites**—$17.1 million for Samos reconnaissance and Midas early warning satellites. Construction planned includes launchers, technical support facilities and tracker and readout stations in both the U. S. and overseas locations.

• **Strategic bomber and tanker facilities**—$49.8 million, including conversion of an existing B-47 base to provide for an additional B-52 squadron dispersal location at March AFB, Calif. It also provides for additions to existing aircraft maintenance docks and armament and electronics shops which are needed to increase the quality and level of maintenance. Another major project is a runway and taxiway replacement at Fairchild AFB, Wash., where existing pavements are failing under sustained B-52 operations. It also provides for mission training facilities and smaller operational and support projects at various bases.

• **Strategic support**—$30.7 million for additional hardening facilities at combat operations centers and other operational and support facilities not associated solely with a single weapon system or objective.

• **Defense missiles**—$26 million to provide an additional Bomarc surface-to-air defense missile site, bringing the total to 16, and to provide additional Bomarc B launchers at 10 of the previously programed sites.

• **Fighter interceptor facilities**—$13.2 million for construction of operational and maintenance facilities for all-weather supersonic F-101s, F-102s and F-106s. About $8 million of these facilities is proposed to be constructed at Alaskan bases.

• **Aircraft control and warning**—$37.7 million is requested to provide expansion and improvements in the radar warning systems. Half of this is for the erection of towers and supporting structures at primary radar sites to house new, more powerful and longer-range radar types and additional electrical power required to operate the equipment. Another $8 million will be used to build gap filler sites to improve coverage in the North American warning system while the remainder is for support and personnel facilities at a number of existing radar sites.

• **SAGE**—$35.1 million of which a major portion will be used to complete construction of the last four centers. The balance is for ground-to-air transmitters and receivers and operations building additions at radar sites to provide for automatic processing and transmission of data from the sites to the SAGE system.

• **Air defense support**—$13.8 million for operation and support facilities related to more than one defense weapon system at various Air Defense Command bases.

• **Tactical missiles**—$17.9 million, of which a major portion will provide hardened facilities for the Mace missile units at overseas locations.

• **Tactical aircraft**—$3.2 million for operational and aircraft maintenance facilities in support of tactical fighter, tanker and transport aircraft.

• **Tactical support**—$3.3 million for various support facilities at Tactical Air Command bases.

• **Military air transport**—$6.6 million for operation and support facilities related to Military Air Transport Service operations and photo mapping and charting activity, including a $3.2 million project to provide working and equipment space at the St. Louis Aeronautical Chart and Information Center required for new intelligence functions.

• **Research, development and test**—$26.9 million, which includes $10.5 million to provide a propulsion engine test cell to test large thrust rocket engines under high altitude conditions at the Arnold Engineering Development Center, Tullahoma, Tenn. Other projects are $2.7 million for an electronics interference reduction laboratory at Stockbridge Test Annex, N. Y.; $1.6 million for a laboratory at Kirtland AFB, N. M., to perform research in high altitude nuclear phenomena, and $2.3 million for additional facilities supporting missile test activities at the Atlantic Missile Range.

• **Training and education**—$22.7 million. Major projects consist of additional technical training facilities to provide training in new skills needed for operation and maintenance of modern space systems, airfield pavements and aircraft maintenance facilities at Perrin AFB, Tex., to provide additional capability for advanced interceptor pilot training in Convair F-102 aircraft.

• **Depot operations**—$10.7 million. Major items include modification of existing industrial type structures at Health Maintenance Annex, Ohio; maintenance of the inertial guidance systems for various missiles, and performance of extremely precise standards calibration, inspection and test of precision measurement equipment.

• **Overseas forces**—$51.6 million. Of this, $13.4 million is to provide essential strategic communications links in the North Atlantic and Middle East. Another $5 million is for additional facilities at a Middle East North Atlantic Treaty Organization base to permit USAF tactical aircraft operations on a rotational basis.

• **Headquarters USAF support**—$3.8 million for construction at Andrews AFB near Washington, D. C. This primarily relates to the move of flying activities from Bolling AFB and Washington National Airport to Andrews AFB, providing additional facilities to complement construction under way.

USAF Altimeter Policy Scored

Washington—Air Force has been charged with discouraging the advancement of mechanical altimeter technology by channeling its business to one company—Kollsman Instrument Co., Elmhurst, N. Y.—and resisting competitive proposals of other firms in the field in a report filed by the Senate Small Business Committee.

The committee's finding is based upon a case study of Aerosonic Corp., of Clearwater, Fla., and the harassments it allegedly encountered in bidding for USAF orders against Kollsman. Committee hearings were held in March last year.

Aerosonic was organized in Cincinnati in 1953 by H. J. Frank, as a manufacturer of flight instruments. It moved to Clearwater in 1956 and employs 105 persons.

Until the congressional investigation resulted in a change in USAF's approach, the committee said in its report that "the Air Force has been content with one supplier of altimeters, although it, with evident reluctance, suffered a second source, in the form of Aerosonic.

"Through the years, the Air Force took no purposeful steps, except perhaps conversationally, to encourage instrument manufacturers to become suppliers of altimeters.

"This reliance on one major supplier has limited improvements in the design and performance of altimeters, with the result that the art of altimetry has lagged seriously behind requirements of modern high-altitude military and civilian aircraft."

Prior to the entry of Aerosonic into the flight instrument field in 1953, the only source of mechanical altimeters for military and civilian planes since 1944 had been Kollsman, the committee said.

The committee urged USAF to consider "a research and development crash program aimed at improving the art of altimetry. That this program should be given prime priority needs no further endorsement than the knowledge that all military and civilian pilots are keenly conscious of the present inadequacies of available altimeters."

USAF has "acknowledged" its "deficiencies" and taken definite steps to broaden the procurement base of altimeters, the committee said. It pointed out that on a recent order of 7,452 altimeters, 73 companies were solicited, proposals were received from 7 concerns,

4 of which were considered technically satisfactory by USAF.

On this order, the committee said the Air Force also broke down the procurement, so that bids might be submitted on 100%, 75%, 50%, or 25% of the total amount, thus opening the competition to small concerns. Aerosonic received 50% of the procurement, and the committee said the first 12 altimeters submitted by the company have passed rigid USAF tests.

The committee recommended that the Air Force "continue to tighten its altimeter repair and maintenance procedures, with emphasis on the establishment of rigid standards for overhaul and testing." Until the committee's hearings last year, the report said "no records were kept by the Air Force identifying the repair shops which reworked malfunctioning altimeters, with the result that slipshod repair work could not be traced to the offending contractor."

Pan American Studies JetStar Lease Plan

New York—Pan American World Airways hopes to take delivery in early 1961 of 15 to 20 Lockheed JetStar executive transports for lease to corporate customers, pending Civil Aeronautics Board approval of the airline's plan to form a subsidiary for the purpose.

Pan American filed the request this month with CAB. Plan involves long term leases, probably with purchase clauses, covering the aircraft and various services such as major airframe and engine overhaul, crew training, interior design assistance, and technical advice. The operation would be performed by an as yet unnamed subsidiary of the airline.

Price of the JetStar with four Pratt & Whitney JT12A-6 turbojets and executive interior is about $1.2 million. Prototypes of the rear-engined jet transport were fitted with two Bristol Orpheus 6,000-lb.-thrust engines, but only the four-engined version with Pratt & Whitney engines is now planned for production (see p. 93). One prototype has been fitted with 3,000-lb.-thrust JT12A-6s and is expected to fly in the four-engined configuration next month. First production model is expected off the line next fall, with first deliveries in January, 1961.

All-British Satellite Program Is Planned

London—Britain's Ministry of Aviation appears optimistic about preparations for setting up an all-British satellite program.

Britain probably could place a space-stabilized satellite in orbit by the mid-1960s, a ministry official told Parliament. The satellite would weigh between 1,000 and 2,000 lb., travel at an altitude of 200-300 mi. and provide a platform for astronomical observation.

Launcher would be a combination of two vehicles—Blue Streak, the long-range (3,000 mi.) military missile so far untested in flight, and Black Knight, the test rocket already fired successfully five times. A small second-stage rocket "which presents no great technical difficulties" would be added.

Two other space projects also are under consideration, said the aviation minister. One would involve an unstabilized satellite of several hundred pounds. It would orbit at 8,000-12,000 mi. to investigate the earth's atmosphere, radiation and magnetic field. The other project would call for a 50-lb. satellite designed to orbit at 100,000 mi. apogee and investigate properties of the sun's atmosphere.

'Unknown' Satellite Tentatively Identified

Washington—"Silent" satellite now in a polar orbit "most probably is the ejected recovery capsule of the Discoverer V" launched last Aug. 13, Defense Department said last week. "Refined analysis of radar returns" indicate the object has a cross section "consistent with" the 2-ft. length and 3-ft. dia. of the capsule, which separated Aug. 14 and was presumed until now to have re-entered, the Department said.

The object is in an orbit with an apogee some 500 mi. higher than that achieved by its launching Agena rocket (AW Feb. 22, p. 38, but Defense said the 1,300 to 1,400 fps. impulse of the capsule's retrorocket was enough to provide that orbit. Further analysis of experimental satellite surveillance tracking records revealed that the object was being tracked as far back as last Aug. 14. Expansion of the Navy-operated Spasur satellite detection fence, which belatedly discovered the satellite in late January, now is expected to be undertaken on an emergency basis.

News Digest

Military Products Division of American Standard Corp. (see p. 81) has been acquired by Northrop Corp. as the Precision Products Department of its Nortronics Division.

Martin Bullpup air-to-surface missile configuration will be developed to handle interchangeable nuclear and conventional warheads, under a $4.5 million USAF contract awarded last week.

Initial launch of a test vehicle for the Army-Martin solid-propellant Pershing tactical missile (AW Feb. 22, p. 39) was made from Cape Canaveral, Fla., late last week. Range of the flight, in which only the first of the vehicle's two stages was ignited, was approximately 20 mi. Primary purpose of the test—to achieve proper ignition of the first stage and to put the vehicle into a ballistic trajectory—was accomplished. The 32-ft. test vehicle was similar in size, shape and weight to the final version of the Pershing missile.

Sperry Gyroscope Co. scientists have generated high frequency (700-2,000 mc.) electrical energy with an oscillator using gyroelectric plasma. System could have space communication uses.

Lockheed Aircraft Corp. has acquired Colby Steel and Manufacturing, Inc., of Seattle, and Colby Crane and Manufacturing, Ltd., of Vancouver, B. C. Colby Steel and Crane produces cranes, elevators, hoists and other materials handling equipment. Colby will operate as a wholly-owned subsidiary of Lockheed under the administration of the Puget Sound Bridge & Dry Dock Co., acquired by Lockheed last year. Acquisition includes a subsidiary of Colby Steel, Eagle Manufacturing Co., of Seattle.

Curtiss-Wright Corp. cut its dividend last week for the second time in six months. Reporting earnings of $14,302,858 for 1959 compared with $25,053,382 the year before, the company dropped its quarterly payment from 37½ cents to 25 cents. Sales declined from $388 million to $329 million. As in the case of its dividend cut last fall from 62½ cents following announcement of a new engine developed in conjunction with NSU of Germany, the company revealed another new product this time, a glass fiber and steel propeller for VTOL applications. Market reaction to the dividend cut was a $4 fall in the price of the company's common stock.

Pan American World Airways is scheduled to begin Boeing 707 turbojet service from Seattle to Fairbanks, Alaska, tomorrow on a four flights per week basis. The 707s will offer de luxe class and first class seating configurations at $250 and $198 round trip respectively. Between Apr. 15 and May 31, a special 14-day round trip excursion fare of $148.50 is expected to be available.

Republic Aviation earned $3,386,000 in 1959 on sales of $197,760,000, preliminary figures indicate. Earnings dropped $1,734,901 under the previous year, when sales were $218,547,879. Backlog is $511 million.

Collins VOR Systems

PROVED BY MORE THAN 33,000 INSTALLATIONS

Collins VOR systems provide highly accurate, reliable navigation service for any type aircraft. The proof of Collins dependable VOR performance is the more than 33,000 system installations in military, business and commercial aircraft — single engine to trans-continental jet. Each system is backed by Collins' 12 years of specialized VOR design and manufacture experience. Choose your navigation receiver from the Collins line of quality VOR systems — one to fit your flying requirements.

51R-3 VHF Receiver

Provides 280 channels with 100 kc spacing between 108.0 - 135.9 mc for reception of localizer, omni-range and communication signals. Weight: 29.5 lbs.

51R-4 Navigation Receiver

A single case unit, the 51R-4 provides complete navigation and communication receiver service utilizing 880 channels with 50 kc spacing between 108.0 - 151.95 mc. Weight: 24 lbs.

VOR-101

The 51X-2 VHF Receiver is combined with the 344B-1A VOR/LOC Instrumentation Unit to provide complete VHF frequency service. The 51X-2 features 880 channels with 50 kc spacing between 108.0 - 151.95 mc. System Weight: 23 lbs. Most popular full service system on the market today.

VOR-102

Utilized where RMI service is not desired, the 51X-2 VHF Receiver is connected with the 344A-1 VOR/LOC Instrumentation Unit for course selection, cross pointer and flag services. System Weight: 19 lbs.

Lightweight Standard Navigation System

The panel mounted 51X-3 VHF Receiver combined with the 344A-1 VOR/LOC Instrumentation Unit provides the same services as the VOR-102. The 51X-3 features 190 channels with 100 kc spacing between 108.0 - 126.9 mc. System Weight: 11.75 (18.25 lbs. with 51X-3 power supply). Deluxe service for light twins.

Lightweight NAV/COMM system

The 344D-1 VOR Instrumentation Unit is combined with the 51X-3 VHF Receiver for Left-Right VOR/LOC indication, reciprocal bearing, To-From information and VOR course selection. System Weight: 5.15 lbs. (11.9 lbs. with 51X-3 power supply). Designed for single engine aircraft and back-up use on twins.

Lightweight Deluxe Navigation System

The panel mounted 51X-3 VHF Receiver and the 344B-1A Instrumentation Unit are combined to provide complete navigation services. System Weight: 15.75 lbs. (22.25 with 51X-3 power supply). Full 190 channel service for medium and heavy twins.

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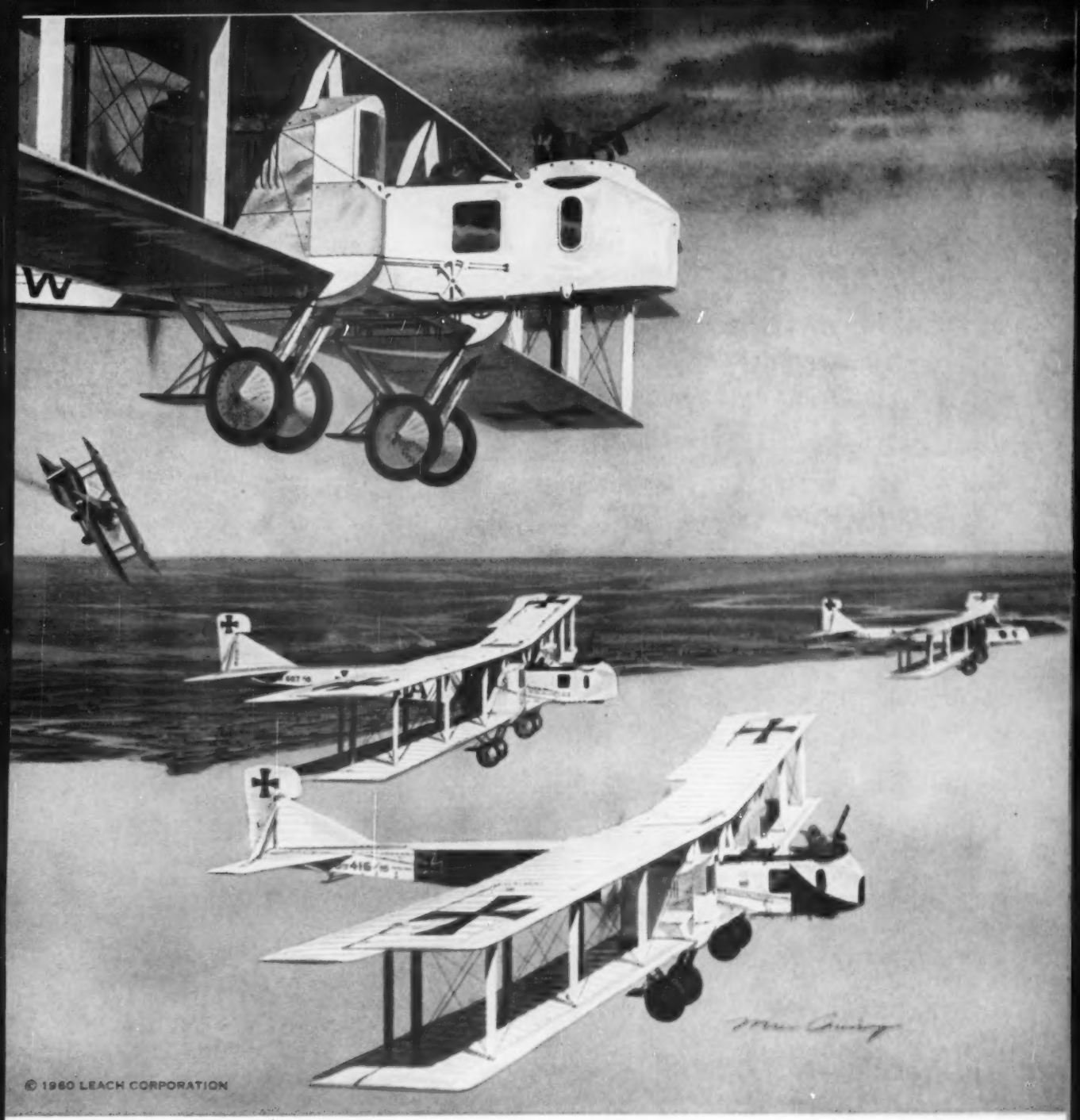

GREAT LONDON AIR RAID SCARE

LEACH HERITAGE OF THE AIR—9

"The warning came through about 10 a.m., and I at once left the ground and climbed my Sopwith Pup towards the Thames. A signal on Bekesbourne aerodrome told me Huns were in the London area. Over Southend at 16,000 ft., I discerned big machines in good formation flying east. As they passed, I dived on the rearmost machine which bore the letters KA, and fired a drum at close range. I put on a new drum and dived from the Hun's right rear to within 300 ft., when I swerved to his rear left, closed to 50 yards and finished my drum. I zoomed away, but the Hun still appeared to be O.K. Then I put on my last drum and repeated my manoeuvre. My tracer bullets struck all about his fuselage and wings, but caused not the desired effect. Without ammunition, I flew abreast of the Gotha at 200 yards making faces at him. The Hun finally put a good burst through my machine, so I flew away from the KA Gotha, whose gunner I decided was a very nasty man!"

Such was the report of his action on July 7, 1917 by Major James T. McCudden, who was to become the deadliest shot of all British aces with 57 kills.

The appearance of Gotha G. IV heavy bombers over England marked the second phase of Germany's attempt to create panic in the country. The first air raids began in the evening of January 19, 1915, when Zeppelins L.3 and L.4 flew over Yarmouth and King's Lynn. Zeppelin raids continued for the next two years doing only sporadic damage. Yet they ultimately forced the Home Defence to tie down 17,341 anti-aircraft troops and 12 R. F. C. squadrons with 110 planes – all desperately needed on the Somme.

As the Zeppelins proved vulnerable to bad weather, anti-aircraft fire and fighter planes, the German High Command turned to long-range bombers. The finest of these was the three-seater Gotha biplane built by Gothaer Waggonfabrik, a.G. Types ranged from the G. I to the G. X, but the G. IV was used primarily for the London raids. Powered by two 260 hp Mercedes motors driving pusher airscrews, the G. IV had a maximum speed of 87.5 mph at sea level.

On May 25, 1917, the Germans launched the first massed Gotha attack on London, but weather prevented them from reaching the city. On July 7 came the daylight raid by 22 Gothas which dropped 72 bombs, killing or wounding 594. It was this flight that McCudden attacked as it flew back to Belgium without losing a plane or a man.

Raids by the Gothas continued until May, 1918. Actual casualties and damage of the 52 aerial raids on England had been tactically unproductive, but there had been a deep psychological effect. Many would remember when, in 1939, they again watched searchlights probing the heavens for planes bearing the black cross.

Heritage of the Air

One of the most inspiring chapters in the history of technical evolution is the story of the men and flying machines of World War I. It is the highly personalized story of brave men – and the wood, wire, linen, and rudimentary technologies that converted manpower to airpower. Today, Leach Corporation celebrates its 40th year in electronics with the presentation of this Heritage of the Air series.

* * *

Technical Director for Heritage of the Air is Major Kimbrough S. Brown, USAF.

Wanted: a better word
that means the same thing
reliability used to mean
before it became "reliability"

"Reliability" doesn't mean a thing . . . not any more.

Repeated use has debilitated the word by eroding its meaning. In short, "reliability" is worn out, the victim of overexposure. If you doubt it, count the number of times the word is used between the covers of this magazine.

What can be done about it?

That's a problem for the wordsmiths. Ours haven't been able to come up with anything that means what "reliability" used to mean.

So we'll continue using the word, but we hope that next time you hear someone from Leach say "reliability" you'll remember it's just our way of saying:

"For over 40 years, we've been making things that work the way they're supposed to, where they're supposed to, when they're supposed to, and for as long as they're supposed to."

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LOOK TO LEACH

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National Product Keys Passenger Growth

Prospects for 14% traffic growth appear strong; trunkline passenger miles may reach 32 billion.

By L. L. Doty

Washington—Prospects for a 14% growth in trunkline passenger traffic in 1960 over last year now appear strong, based upon an AVIATION WEEK chart detailing the close relationship of revenue passenger miles to the gross national product.

Using a Commerce Department projection of an annual Gross National Product of $510 billion by the end of 1960, the chart—prepared from statistics provided by the Air Transport Assn.—indicates that trunkline passenger revenue miles will reach a quarterly rate of 8.08 billion by mid-1960 and an annual rate of 32 billion by the end of the year.

Remarkable showing of heavy traffic increases during January in the face of a rash of highly publicized airline accidents give strength to the promising forecast brought out in the chart's projections. Revenue passenger miles last month reached 2.41 billion—a figure that has been topped in only two previous months in airline history.

Opinions within the industry vary slightly as to the full significance of the chart, but a growing number of airline analysts and economists are beginning to rely heavily upon this type of projection as the most reliable means of forecasting traffic growth on a short-term or one-year basis. This group also points out that the increasing importance of trunkline revenue passenger mile figures to the general economy now warrants their use as a factor in any wide-scale analysis of business trends.

Economic Facts

Here are a few of the economic facts revealed in studies of the chart:

• **Airline traffic periodically** diverts from general economic trends. This may be due to industry strikes, as in the case of the third quarter of 1954 and the fourth quarter of 1958, or to airline accidents, as in the third quarter of 1956 which followed the midair collision over the Grand Canyon in June of that year.

• **Airline activity** normally does not react sharply to short-term disruptions of the economy. Industry traffic held firm during the steel strike while the railroads are attributing 1959's decline in earnings directly to that strike. Airlines, such as Capital and Allegheny whose routes serve the high density traffic of the steel areas, will show a reaction to the strike, but the effect on the airline industry generally is imperceptible.

• **Airline passenger traffic** remains relatively stable during periods of general economic recessions. In the 1954 recession, the GNP dropped below the peaks reached in 1953, but the level of airline traffic did not decline in absolute terms, although it did fall below its trend as shown by the chart. In the 1958 recession, airline traffic in some months dipped slightly below its 1957 level, but the decline for the entire year was a bare 3%. The GNP receded sharply in 1957.

Enthusiasm Off Slightly

Generally, most economists are still holding to earlier predictions that 1960 will be a boom year. However, the enthusiasm which existed at the turn of the year has been toned down slightly by the relatively slow pace of the economy during January.

Nevertheless, the forecast of a $510 billion GNP by the end of the year has not been adjusted and a number of analysts are now saying that the steadiness experienced in January in place of a spiraling boom may have precluded any possibility of another wave of inflation which was expected to accompany this year's prosperity.

On these assumptions, revenue passenger miles can be expected to develop as predicted, and the steadily rising expense level probably will not be accelerated by an onslaught of general inflation. As it is, most industry officials are now geared to meet an impact of expense increases that may be greater than the estimated 19% expense hike experienced last year.

Labor costs can be expected to climb during 1960 since most union contracts settled during the troublesome period of strikes in 1958 will come up again this year for renegotiation. A full recurrence of the 1958 difficulties is not expected this year, but most observers agree that 1960 will not be the complacent year in the labor field that 1959 was.

Costs of introducing jet equipment will be especially high this year, since such expenses as pilot training and mechanic indoctrination are not normally capitalized or amortized over several fiscal periods but are usually absorbed at the time the cost is incurred. As previously pointed out (AW Dec. 14, p. 39), long-term interest costs and depreciation expenses will be unusually high this year.

Many Variables

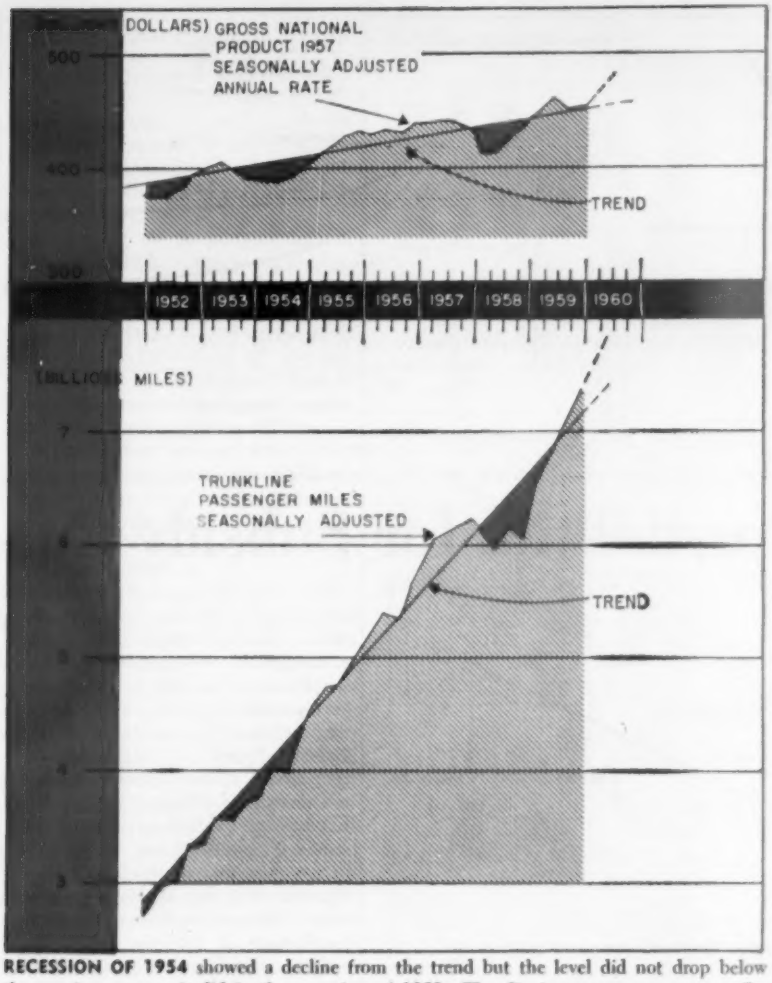
It is not entirely fair to attempt a prediction of revenue trends with any fine degree of accuracy by relating the passenger revenue mile factor to gross intake because of the many variables involved in pricing the airline product. Only passenger traffic can be considered in any study of airline revenues since cargo revenues—historically representing only a small fragment of over-all revenues—has declined consistently in the past five years in its ratio to passenger revenues even though freight volume has increased over the same period of time.

Key to the revenue picture this year—and the most pivotal of all variables—is the forthcoming decision in the Civil Aeronautics Board General Passenger Fare Investigation. If a rate rise is granted, most carriers will file tariffs to take advantage of the authorized increase.

At the same time, the rate pattern will be further affected by fare adjustments designed to offset seasonal traffic declines which are not shown by the GNP chart. Capital already has taken a step in this direction with a seasonal summer rate it proposes to introduce between New York and most other cities on its system.

In addition, jet surcharges may be removed this year, either through a CAB suspension or through competitive pressure. The jet surcharge last year served as a major factor in bolstering revenues of jet operators since it represented an approximate 6% increase on transcontinental fares.

Another unpredictable variable is the erosive effect the trend toward more coach seat miles will have on over-all revenues. At present, most major carriers are taking a second reading of their coach commitments although there are no visible signs as yet of any major retrenchments in aircoach scheduling.



RECESSION OF 1954 showed a decline from the trend but the level did not drop below the previous year as it did in the recession of 1959. The dip in revenue passenger miles in 1955 was due to airline strikes. Slow recovery in the fourth quarter of 1958 and the first quarter of 1959 was due to strikes. The Grand Canyon midair collision is reflected in the dip of 1956. Chances are strong that the first quarter of 1959 will show the same reaction due to the recent incidence of airline crashes. On the basis of the Department of Commerce forecast of a $510 billion gross national product in 1960, revenue passenger miles in 1960 will reach 32 billion for a 14% increase over 1958.

Since the GNP chart is a mechanical-type projection, the forecast does not reflect these variables. For example, in projecting revenue passenger miles in their relationship to the GNP, no thought is given to claims that the attraction and public popularity of jets has generated new traffic and thus launched a new period of air travel expansion.

Jet Factor

Last year's traffic growth—16.7% in revenue passenger miles over 1959—gives some credence to these claims, but it is still too early to analyze accurately the full effect jet service has had in opening new markets or invading those now served by surface transportation.

Despite these variations, always present in any forecast, the chart has proved itself an accurate forecaster of revenue passenger miles in the past and has served as a reliable guidepost in analyzing traffic patterns against traffic trends and the general economy. In addition, it has proved of value in the projection of available seat miles in accordance with general market fluctuations

Seasonal Changes

The chart should not be interpreted to show that seasonal traffic trends will not dip sharply for short periods of time when the GNP remains firm or even rises. Airline traffic decidedly does fluctuate in this manner throughout the year.

However, trunkline passenger miles used in the chart represent quarterly data adjusted to remove the effect of these typical seasonal variations. This adjustment permits comparison of consecutive quarters unobscured by the heavy seasonal changes normally experienced in traffic patterns.

Gross National Product figures used in the chart for each quarter reflect "seasonally adjusted annual rates" as prepared by the Commerce Department. To eliminate the effect of inflation, the series used in the chart is based on constant dollars of 1957 value.

Travel Agent Fare Rejected by CAB

Washington—Domestic trunkline attempts to offer a 50% fare discount to travel agents as a sales incentive have been rejected by the Civil Aeronautics Board by a three-two vote.

The Board's disapproval of resolutions submitted for approval by the Air Traffic Conference was criticized strongly by the two dissenting members, Vice Chairman Chan Gurney and G. Joseph Minetti, who favored holding full hearings on the resolutions.

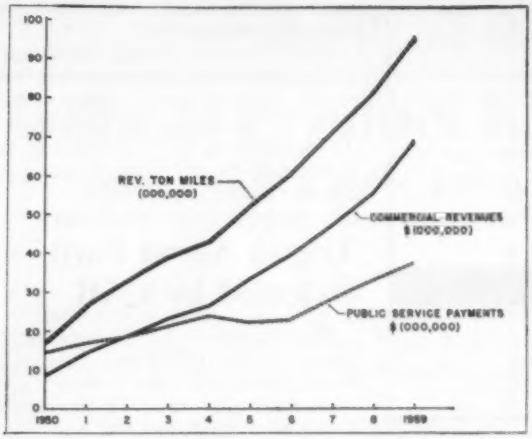
Urging approval of the ATC resolutions, which would have provided reduced rate transportation for travel agents, as well as free transportation for tour conductors, American and Northwest Airlines and American Society of Travel agents told the CAB that adoption of the fare resolutions would promote new traffic by stimulating additional interest in domestic air tours.

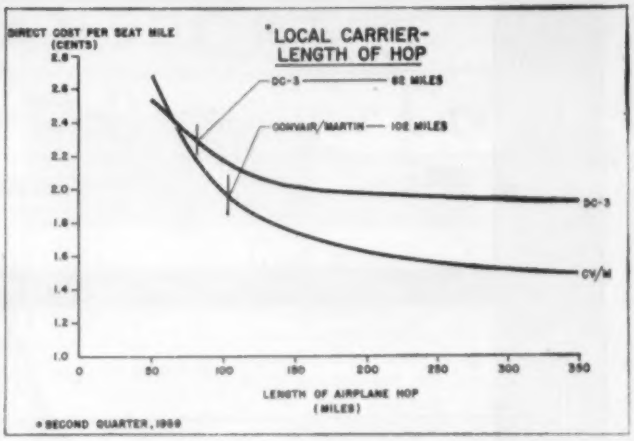
In rejecting the request, CAB found the resolutions in violation of sections of the Federal Aviation Act covering discrimination and also contended that none of the carriers submitted any factual evidence to indicate a justification of the ATC resolutions.

Although special fares are sometimes permitted in cases involving "extraordinarily important and serious business" matters, the Board said the request for approval of the ATC resolutions failed to meet this test.

While Gurney and Minetti agreed with the majority voters that neither the airlines or ASTA justified their requests, they said the ATC resolutions should have been brought to a full evidentiary hearing, and, if not heard or granted, the CAB should sponsor an amendment to the FAA Act to permit the reduced rates.

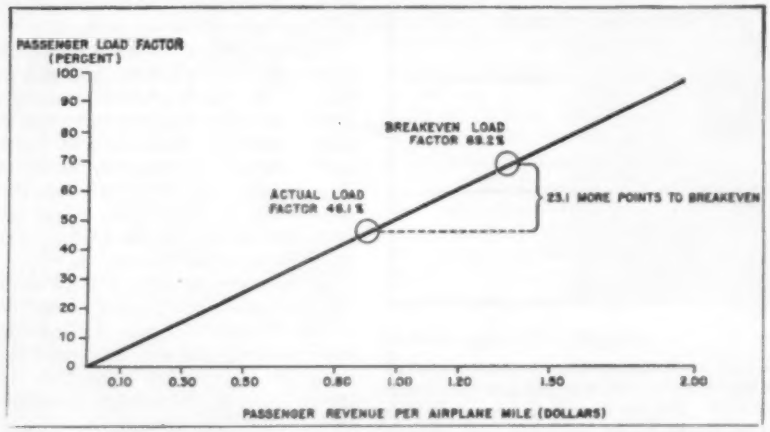
Emphasizing the importance of finding a means to stimulate traffic to fill the industry's increased seat capacity, the two dissenters said they viewed the airlines' proposal as a "design ultimately aimed at stimulation of domestic travel" and a step that could aid the industry in matching its seat mile growth with a comparable rate of traffic growth. They added that unanimous approval of the resolutions by the ATC members should make it necessary for the CAB to examine the proposal in more detail.



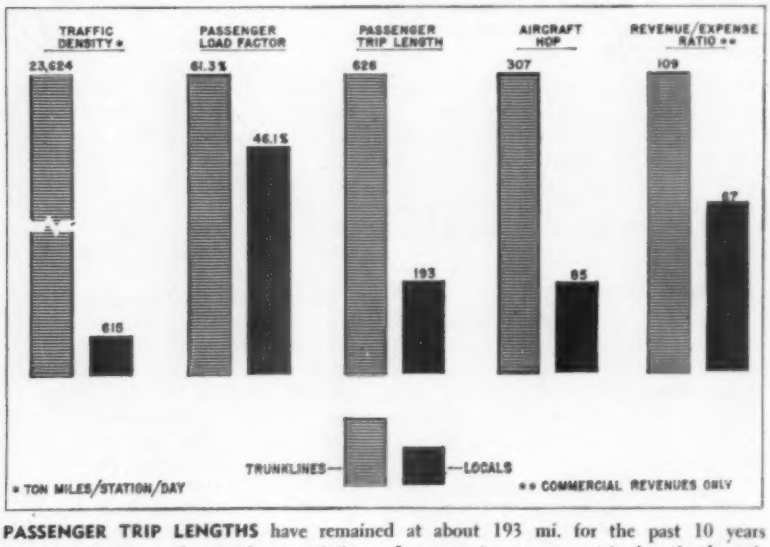


COMPARATIVE GROWTH of local services and public payments is shown at left. Direct cost and length of hop are shown at right.

Study Cites Possibilities for Subsidy Cuts


PASSENGER LOAD FACTOR (PERCENT)
BREAKEVEN LOAD FACTOR 69.2%
ACTUAL LOAD FACTOR 46.1%
23.1 MORE POINTS TO BREAKEVEN
PASSENGER REVENUE PER AIRPLANE MILE (DOLLARS)

LOCAL AIRLINES have endeavored to raise revenues by increasing passenger load factors. In 10 years the average passenger load factor increased from 28% to 46%.



PASSENGER TRIP LENGTHS have remained at about 193 mi. for the past 10 years because of route and operating restrictions. Increases in passenger trip length through operation of more modern aircraft and other means have been offset by addition of intermediate points.

Los Angeles—Substantial reductions in subsidy payments to local service carriers can be effected if capital is made available for equipment modernization and certain restrictive regulations are modified, according to a study compiled for the Assn. of Local Transport Airlines. Specifically, the study of 13 local service domestic airlines conducted by the Planning Research Corp. found that subsidies, which totaled $37.5 million in Fiscal 1959, can be cut if local service revenues are increased through higher load factors, longer stage lengths, more efficient equipment and fairer distribution of interline revenue.

The report found that, while subsidy has grown in the 10-year period since 1950 from $15 million to $37.5 million, the ratio of subsidy to revenue has declined. In 1950, subsidy amounted to 53.9% of local service revenues but amounted to only 33.6% of total revenue in 1959.

The average local airline system is relatively weak from the standpoint of profits, the study concluded. Specifically, it found that low traffic density and passenger load factors of the local service airlines result in substantially less traffic and revenue for each aircraft departure than for the trunkline departures.

Local service passenger trip length is only 193 mi. compared with 626 mi. for the trunkline passenger.

The resultant higher unit costs coupled with the low load factors create operating costs per ton mile which are more than double those of the trunklines.

In terms of direct operating costs, which include costs of operating aircraft, progress also has been made. The cost per aircraft-hour or per aircraft-mile shown by the local service airlines compares favorably with trunkline costs for similar aircraft.

IATA Emergency Meet

Paris—Two or three month prolongation of current fares on North Atlantic and other international routes may be the immediate outcome of an emergency meeting of International Air Transport Assn. which opened here this week (AW Jan. 11, p. 34).

Meeting of the international carriers was necessitated by failure to reach agreement on certain international fare structures at the IATA meeting in Honolulu last fall (AW Oct. 19, p. 38). At stake in the current IATA meeting are new fare patterns on North and mid-Atlantic routes, European routes to Africa and the Far East and transpacific routes.

Rates on these segments expire Mar. 31. If agreement is not reached by then, fares on these routes theoretically are open. The Paris emergency session was decided on as a final attempt to head off an open rate situation.

In Paris, as the IATA session got under way, there was little evidence that a quick compromise was in the offing. Most observers looked for a long session lasting perhaps two to three weeks. Because of this, many carriers seemed favorable to the idea of extending present fare patterns on disputed routes for several months, perhaps to May 31. By doing so, it was being argued, the carriers could thrash out their differences at the current session without the Mar. 31 deadline threatening them.

Major obstacle to any agreement still seemed to be the desire of British Overseas Airways Corp. to retain three classes of service over various routes, including the North Atlantic, plus its determination to introduce economy fares on Europe to Africa and Far East routes which would be from 10 to 20% below current tourist rates on these routes.

Douglas DC-3 direct cost per hour has been $90 for trunklines, $88 for local service lines. For the Convair 240 and Martin 202, trunkline costs have been $165 per hour versus $164 for the locals.

The report shows that in a period of more than a decade, the local service industry has paid only $23,750 in common stock dividends, indicating that subsidy is not required because of a siphoning of earnings.

Greatest opportunity for reducing subsidy payment volume lies in the increase of load factors. Actual load factor is now 46.1%, according to the report. Load factor required to break even is 69.2%, a 23.1 point disparity. For each percentage point increase in load factor, an additional 2.2 cents of revenue per plane mile results, or an increase of approximately $1.4 million per year in gross revenues for the local service industry.

The report concludes that, if load factors are to improve and more nearly approach the breakeven point, access to greater traffic potential must be provided for the local service carriers. It added that recommended greater freedom of operation, such as the skip-stop authority, will not result in deterioration of service to smaller intermediate points since minimum service patterns to such points should be required.

Purchase of more modern, efficient aircraft will increase revenues and provide faster and better airline service at lower seat mile costs. Costs of DC-3 operation at a stage length of 82 mi. is 2.3 cents per seat mile. A composite of Convair and Martin costs shows a level slightly less than two cents per mile at a stage length of 102 mi.

The report recommends that, in the interest of reducing subsidy, an investigation should be undertaken by the Civil Aeronautics Board to determine if the local airline share of interline passenger fares should be increased. Two methods of revising present tariff regulations to bring this about are suggested:

- **Retention of an "originating cost"** portion of interline tickets by all originating carriers. Analysis will be required to determine what a fair average "originating charge" should be and the extent to which present or future interline passengers originated by the local airlines equal or exceed those originated by the trunks. Growth rates of local carrier passengers clearly exceed those of trunkline passengers.
- **Retention of a "commission charge"** by all carriers based on a percentage of gross sales over each other carrier's system. This concept has been in effect for a number of years among bus lines of the U. S. All airlines pay a commission to travel agents for tickets sold but have not paid commissions to one another, apparently on the theory that such commissions would cancel out or offset one another in clearing house settlements. The wide disparity in relative ticket size between the trunklines and the local carriers makes it doubtful that such an offset occurs between these two carrier groups. The average trunkline ticket for Fiscal 1959 was 2.6 times the size of the average local carrier passenger ticket.

Britain Plans Supersonic Study

London—British government has asked the country's two new airframe groups and its two engine groups to make design studies for a supersonic airliner.

Minister of Aviation Duncan Sandys told Parliament he is awarding separate study contracts to the four groups—but he emphasized that "when we get the results of these studies then there is no thought of placing two contracts for two supersonic airliners."

Reason for awarding the four separate contracts, Sandys said, was the belief that "in the initial stage, where it is a matter of studying the problem, there would be an advantage in getting the separate views of these firms."

The groups involved are Hawker Siddeley and de Havilland, and Vickers-Bristol-English Electric on the airframe side, Rolls-Royce and Bristol Siddeley on engines.

Award of the study contracts does not mean Sandys has decided that the British industry should develop a supersonic civil airliner entirely on its own. He said that as well as investigating technical questions—including optimum speed—and economic prospects, the firms have been asked "to explore the possibility of collaboration with suitable foreign firms."

There is much difference of opinion within the industry as to whether the British should go ahead on their own or in collaboration with the U. S. They are admittedly well behind the U. S. in pertinent knowledge. Bristol's all-steel T.188 is the only research aircraft now under development, though Hawker Siddeley has had an advanced projects group studying supersonic air travel for a couple of years.

As Sandys told Parliament, British firms have been in contact with U. S. firms in the fields.

British firms were asked last year to consider findings of a committee appointed in 1956 by the Ministry of Supply. The committee recommended detailed design work on two supersonic aircraft—a long-range version to cruise at Mach 2 and a medium range version to cruise at more than Mach 1.

Although Sandys gave no time indications, industry sources report that the question is being treated with urgency and that studies are due soon.

British estimates for development of a supersonic airliner range from around $300 million to around $600 million. Sandys gave no indication of what the government contribution would be to development costs, but it would presumably be substantial, in view of Sandys' recent policy statements on government support generally.

Dr. Barnes N. Wallis, designer of the Swallow variable-geometry aircraft, said at the opening of the first engineering materials and design exhibition in London that there is an immediate need for a new material "which will maintain its strength and elasticity at temperatures of 300C."

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SYDNEY — SAN FRANCISCO – 14 HRS. 48 MIN.

PARIS — NEW YORK – 6 HRS. 45 MIN.

NEW YORK — ROME – 7 HRS. 48 MIN.

SAN FRANCISCO — NEW YORK – 4 HRS. 16 MIN.

DALLAS — CHICAGO – 1 HR. 28 MIN.

MIAMI — NEW YORK – 1 HR. 45 MIN.

DENVER — CHICAGO – 1 HR. 33 MIN.

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Patterson Foresees Trunkline Mergers

Honolulu—W. A. Patterson, president of United Air Lines, warned last week that by 1961 mergers within the trunkline industry will be the only solution to the financial difficulties many carriers will face as the result of growing competition for traffic in major markets. He predicted that the necessity for such mergers will begin to become evident as early as September.

The 60-year-old executive, here as host to a press flight launching United's Douglas DC-8 scheduled service between the West Coast and Hawaii, told AVIATION WEEK that the Civil Aeronautics Board is not yet conditioned to the full need for mergers as the only way of averting financial chaos within the industry. He said the problems will stem from the heavy jet operating cost burden, which some carriers will not be able to carry, and from the high rate of available seat miles which the jets will generate.

At the same time, Patterson formally announced the purchase of 20 Sud Caravelle transports, with option on 20 more, to be powered with Rolls-Royce Avon Mark 531R turbojet engines at a cost of $65 million for delivery in the spring of 1961. The Caravelle purchase will bring United's total investment in turbojet aircraft and spare parts to $383 million. This includes 40 Douglas DC-8s, of which 18 have been delivered, and 18 Boeing 720 medium-range turbojet aircraft on which delivery begins this spring.

Additional Order

In addition, an order will be placed for 40 Boeing 727 transports powered by three 10,000-lb.-thrust aft turbofan engines (AW Feb. 22, p. 49) which will bring the total jet investment up to $575 million. The order will be placed in the early fall if the manufacturer indicates it will go ahead with production of the aircraft.

Boeing stated earlier that design work on the plane has been under way for four years and that it could have the first models available for service by 1963 if production were begun now.

Patterson, who is planning a 1964 delivery date for the 727s if United places an order, is convinced that there is a market for the airplane.

Patterson said financing of the re-equipment program has been completed up to 1964. Methods of financing to be undertaken after that time will depend upon conditions then in money markets. He said United has improved its equity position substantially during the past four years and that earnings are now being applied toward the purchase of new aircraft.

W. A. PATTERSON

On the subject of mergers, he charged that CAB's 1955 policy of strengthening weak carriers by expanding their routes is directly responsible for the strong competition that exists between carriers today. He admitted that the scramble for traffic in this highly competitive period could result in a lowering of fares by some carriers as a means of "staying in business" by filling the high volume of seats being brought about by the jets.

In this connection, Patterson called upon the Board to use "soundness and good judgement in passing on any low fares" filed as competitive tariffs. He said United is ready to match any rates introduced by competitors, adding that the "position of the bulkhead" separating coach from first-class traffic on United's jet aircraft "will be determined the demands of the traveling public."

Patterson feels that the difference between coach fares and first-class rates is now too wide since, with the split configuration of the turbojets, each category of passenger enjoys the same speed, schedule and aircraft model. He urged the Board to also study the current rate structure once the General Passenger Fare Investigation is completed.

Supersonic Transport Views

Patterson was quick to argue with claims that a supersonic jet transport could be placed into practical service as early as 1967, stating that such an aircraft was at least 12 years off. He said technological problems and heavy financial undertaking involved stood in the way of immediate development of the aircraft, adding that the industry must pay off some of its current indebtedness supporting present jet fleets before it looks to another generation of aircraft.

He said United will put increased emphasis on military contracts in order to utilize the company's fleet of Douglas DC-7s. Last year, the airline undertook a large volume of charter work as a means of maintaining a high utilization with its piston-engine aircraft in the face of jet competition by TWA and American.

United has revised its original order for 40 DC-8s powered by Pratt & Whitney J57 engines to include 15 planes equipped with the later Pratt & Whitney J75 turbojet. First of this model was used on last week's press flight which flew from New York to Honolulu in 9 hr. 53 min. and from San Francisco to Honolulu in a record-breaking time of 5 hr. 27 min.

United will begin DC-8 service from the mainland to Hawaii on Mar. 14 with an initial schedule of six weekly flights from Los Angeles and a like number from San Francisco. Beginning June 10, the airline will operate an all-jet fleet on the route with 23 weekly flights between the mainland and Hawaii.

Passenger Seating

For its Hawaiian service, United has arranged a configuration of 28 first-class seats and 89 coach seats. First-class cabin includes an eight-seat lounge.

In designing the DC-8 interior, United used a full-scale mockup of the aircraft's fuselage to determine the best scientific arrangement of cabins, lounges and compartments.

First of the carrier's DC-8 fleet was delivered in June and service began with the J57-powered aircraft in September on the carrier's transcontinental route.

By January, the fleet, which then consisted of 10 DC-8s, had accumulated 2.3-million flight miles.

New F-27 Orders Planned by Carriers

Hagerstown, Md.—Quebecair airlines of Canada announced plans last week to purchase one Fairchild F-27 transport as an addition to its present fleet of three. Sales to other carriers of at least 10 of the turboprop airplanes may be announced early next month by Fairchild Engine & Airplane Corp.

Ozark Air Lines says it may increase its F-27 fleet from three to five aircraft, and negotiations between Pacific Western Airlines and Fairchild for the purchase of at least three F-27s have reached the final stages.

Turkish Airlines plans to buy five F-27s from Fairchild and five of the same model—designated the Friendship—from Fokker of the Netherlands.

The Turkish order boosts F-27 firm orders to 83 aircraft, Fairchild said. The F-27 now is used by 24 world airlines; in addition, 30 Friendships have been sold for corporate use.

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TWA May Spark 707, DC-8 Jet Race

By David H. Hoffman

New York—Trans World Airlines probably will touch off a new coast-to-coast speed race on Mar. 1 when it introduces the Boeing 707-331 intercontinental jet transport on its New York-Los Angeles route and advertises a 15 to 20 min. time-saving over rival carriers' service.

Current schedules of TWA, American Airlines and United Air Lines—the three trunklines authorized to fly nonstop from New York to Los Angeles—list block-to-block times of 5 hr. 55 min. westbound and 4 hr. 45 min. eastbound.

Now TWA, in a move calculated to win a speed advantage, promises to cut these times to 5 hr. 35 min. westbound and 4 hr. 30 min. eastbound by using the 303,000 lb. gross weight turbojet.

Maximum Cruise

TWA will fly the 331 at maximum cruise of Mach .84 or .85. United Douglas DC-8s on coast-to-coast flights and American 707-123s on most route segments use a minimum cost cruise of Mach .82, although American boosts this to Mach .84 or .85 on some "highly competitive" but shorter range domestic runs.

Fuel consumption of the jets, which increases rapidly at speeds above Mach .82 and limits flight range, probably will prevent United and American from using maximum cruise power on transcontinental trips in an effort to equal TWA schedules. Carrying up to 40,000 lb. more fuel than the DC-8 or 707-123 and having two to three hours more endurance even at maximum cruise, the TWA 331 can afford to trade some operating efficiency for its speed advantage.

Publishing identical schedules from September, 1959, when United introduced DC-8s on its Los Angeles run, the three carriers up to now have skirted the question of speed in their advertising. All realized that unchecked competition on the transcontinental route would boost fuel and engine maintenance costs sharply if the DC-8s and smaller versions of the 707 were pushed beyond optimum cruise of Mach .82.

Stalemate

With both aircraft capable of attaining Mach .90 or .91 in level flight, a three-way stalemate prevailed within the industry last fall. According to TWA, the three trunklines reached "a tacit agreement" not to use the superlative "fastest" in their advertising copy.

In January, however, United began alluding that its DC-8s enjoyed a slight speed advantage over the Boeing 707-123s of American and 707-131s of TWA. "In the area of speed alone," President W. A. Patterson wrote in United's employe newspaper, "DC-8 Jet Mainliners some time ago overcame any slight initial competitive disadvantage.

"Today, on coast-to-coast flights for example, they are as fast or faster than 707 flights operated at about the same time and under similar wind-and-weather conditions."

Patterson's opinion was reflected in a new schedule of United newspaper advertising that appeared during the week of Feb. 15 in cities across the country.

Stating that "When it comes to making real time coast-to-coast, performance records prove there's no jet faster than United's DC-8 Mainliner," the advertisement revived arguments among flight crews and airline officials over the merits of the 707 and DC-8.

Latest trunkline performance data released by the Civil Aeronautics Board showed that the number of United DC-8 flights reaching California more than 30 min. behind schedule was about double that of TWA and American 707s flying the same routes.

Comparison

Here is a comparison of the three carriers' performance on transcontinental operations in November:

• **Westbound.** United's Flight 817 to Los Angeles arrived more than 15 min. late on 19 of 26 trips, while United's Flight 801 reached San Francisco at least 15 min. behind schedule on 20 of 28 operations. This meant that less than 28% of the carrier's westbound flights were meeting schedule within 15 min. Flying to Los Angeles, about 49% of American's jet trips and 58% of TWA's jet trips met schedule within 15 min. during November.

• **Eastbound.** United's Flight 800, which left San Francisco for New York 27 times, arrived over 15 min. late 22 times and less than 15 min. late five times. Only about 13% of United's eastbound flights were less than 15 min. late at Idlewild, while the comparable figure for American was 24% and for TWA, 40%. One United flight from Los Angeles did not land once within 5 min. of schedule out of 27 November operations.

Even though only one 331 jet is to be flown transcontinental by TWA, United intends to drop the "none faster" claim from its advertising copy, at least until this spring. Then the carrier hopes to introduce DC-8s powered by Pratt & Whitney JT4 (J75) engines on its cross-country routes and regain its competitive position.

Prime purpose in placing the 331 in domestic configuration on the Los Angeles route, TWA admits, is to allow the company to advertise top speed coast-to-coast. In addition, the plane will carry five more passengers—three tourist and two first class—than 707-131s in standard 111-seat configuration.

Accurate speed comparisons between the 707 and DC-8 series transports are nearly impossible, primarily because of the number of engine/airframe combinations available to using carriers. Differences in cruise and climb power settings authorized by the carriers also complicate the picture.

Modified JT3s

The DC-8s operated by United, for example, use 265,000 lb. as maximum gross takeoff weight when equipped with modified JT3 (J57) engines developing 13,500 lb./thrust. With the JT4 which develops 15,000 lb. thrust, the same basic aircraft may take off at about 309,000 lb.

Climbing at constant thrust, the jet transports require repeated power reductions as fuel is consumed and gross weight decreases. This gears the time when cruise power can be applied to the plane's weight at takeoff and affects the flight's point-to-point groundspeed.

Douglas Aircraft Co., Inc., the DC-8's manufacturer, has admitted that its plane now trails 707 transcontinental flights by "one to three minutes." The company feels, however, that this disadvantage will be transformed into a competitive time saving by an aerodynamic improvement program on the JT3-powered DC-8.

Program Implementation

Now being implemented at the Douglas plant, this program involves the following:

• **Extending the DC-8 wing tips.** This modification, which is being incorporated in planes on the Douglas production line, can be performed in "a few minutes" on DC-8s already delivered with a kit developed by the company.

• **Changing the DC-8 flap linkage.** By drooping the flap slightly, a change in over-all wing camber is effected. This is expected to reduce drag and add several knots to the plane's cruising speed.

A third modification, worked out in Douglas wind tunnels, is being weighed pending flight tests. This entails adding a bulge to the inboard side of each engine pylon at its intersection with the underside of the wing. This is expected to improve airflow at the joint and increase the present reverse camber of the wing, according to Douglas.

Slick Supports Aircraft Loan Bill Against Major Airline Opposition

Washington—Slick Airways has emerged as the most vigorous industry proponent of legislation authorizing government-guaranteed loans to stimulate the purchase of cargo aircraft.

The two most vocal opponents of the measure are American Airlines and the Flying Tiger Line, which, along with Slick, have a major stake in the cargo market.

The Senate's Commerce Aviation Subcommittee headed by Sen. A. S. Mike Monroney (D.-Okla.) has completed hearings on the legislation and will act on it in executive session within the near future (AW Feb. 15, p. 39). Monroney and Sen. Stuart Symington (D.-Mo.), long interested in airlift capacity as a means of increasing military mobility, are the co-authors. The measure is supported by Department of Defense, Federal Aviation Agency and Civil Aeronautics Board. The two subcommittee members who attended sessions regularly—Sen. Clair Engle (D.-Calif.) and Sen. Andrew Schoeppel (R.-Kan.)—are opposed. The outcome depends on subcommitteemen who, thus far, have indicated little interest: Sen. George Smathers (D.-Fla.), Sen. Strom Thurmond (D.-S. C.), Sen. E. L. Bartlett (D.-Alaska), Sen. Norris Cotton (R.-N. H.), and Sen. Thruston Morton (R.-Ky.).

At the hearings, Slick said its cargo re-equipment plans call for purchase of four Canadair CL-44D turboprop transports and four turbofan Boeing 735s. With ground equipment and establishment of a station network, it involves an investment of $66 million. American and Flying Tiger reported on the cargo aircraft they already have financed.

Loan guarantees by the Canadian government are available on the Canadair purchases, so the Monroney measure would only affect the Boeing purchase planned by Slick. Alwin W. Johnson, Slick executive vice president, anticipated that the eight new aircraft would be ready for service by April, 1963, and told the subcommittee:

"In the past, Slick has been compelled to pay interest rates of up to 15% on new capital. Such financing costs represent a virtually insurmountable barrier to expansion plans. Financing should be available at a cost of about 5% if the all-cargo industry is to develop properly. Slick believes government guaranty of loans for the purchase of modern aircraft and ground equipment. . . would be a major contribution toward obtaining this kind of financing. Such legislation would stimulate renewed lender confidence in the future of the air freight industry and bring forth investment funds on much more reasonable terms than are presently available."

American's cargo fleet consists of 10 Douglas DC-6As, costing approximately $1.2 million each, and five DC-7Fs, converted from passenger aircraft, at a cost of $485,000 each, plus an additional five DC-7Fs now in the process of conversion for cargo service. Dwight Taylor, an American vice president, told the Monroney subcommittee that his company anticipates a "breakthrough" in cargo aircraft which would warrant re-equipment in the 1964-65 period. In the meantime, Taylor said the government should assist in the advancement of the program with military cargo developments. He told the subcommittee:

"The most solid program . . . would be to appropriate funds for the modernization of the military fleet, predicted on no spending until an effective airplane is developed. There could be a 'military competition' among the manufacturers for the development of the most efficient type."

Air Force is now seeking proposals from manufacturers for a turbofan cargo aircraft for the Military Air Transport Service. The aircraft would have a range of up to 5,000 mi. with a carrying capacity of up to 70,000 lb. (AW Feb. 15, p. 38). V. A. Johnson, Lockheed Aircraft Corp. vice president, estimated the development cost of such an aircraft, exclusive of the engine, at $130-$140 million. He said it could be ready for service by late 1963, and the cost of a commercial version would be approximately $6 million.

With orders for 100, Johnson reported, Lockheed could produce its turboprop Super Hercules 207 at a fly-away cost of $4.4 million by early 1962. He said this aircraft would have lower operating costs than the turbofan type at ranges under 2,000 mi. and comparable costs in the 2,000-3,500 mi. range bracket.

Donald W. Douglas, Jr., president of Douglas Aircraft Co., said his company has told Pan American World Airways it would move into production of its long-range swing-tail cargo DC-8A with an order of from 5-to-10 aircraft. The plane would be ready for service in 1962, with a fly-away cost of $7 million. Douglas said $250 million already has been invested in development of the DC-8 passenger version and that an additional development cost of $50 million would be required for the cargo version.

Douglas estimated that an investment of $1 billion would be required for development of a supersonic transport aircraft. He said progress on the North American B-70 Mach 3 program, recently cut back by the Air Force (AW Dec. 7, p. 26), will determine in large measure when industry moves forward with a commercial supersonic transport.

In opposing government guaranteed loans for cargo aircraft purchases, Taylor of American suggested that there would be a natural tendency on the part of Civil Aeronautics Board to favor the carriers which had such loans in considering route and certificate renewal cases. He asked the subcommittee: "Would it be possible for the CAB wholly to eliminate from its thinking a natural desire to make a loan pay out, which the Board itself has guaranteed?"

Examiner hearings on renewal of the certificates of Flying Tiger and Slick, which expire May, 1961, are now under way.

Robert Prescott, president of Flying Tiger Line, reported that the carrier is scheduled to receive deliveries on 10 Canadair CL-44s between January and June of 1961 and "will probably order more aircraft this spring." It is estimated that this aircraft will be able to reduce the user rate for air freight to 10-13 cents a ton-mile as compared with the 20-23 cents on the DC-6s and DC-7s now in service with American Airlines.

Opposing government guarantee of loans because "it tends to benefit the companies which have not demonstrated the financial and operational ability to succeed while, at the same time, hurting the very companies who have shown such ability," Prescott told the subcommittee:

"If you are going to help our competitors after we have gone through the sweat, struggle, blood and tears of doing our own financing, then we have a right to say something."

Third Pilot Debate

Washington—Attempt by a group of Trans World Airlines' pilots to poll all TWA pilots on the advisability of accepting lower monthly flight hours in lieu of a third pilot on jet transport crews was blocked last week by a vote of Air Line Pilots Assn.'s Master Executive Council for the airline.

Replying to a request by TWA pilots of ALPA's Local Council No. 4 in Los Angeles (AW Feb. 8, p. 38), the executive council representing the officers of all TWA local councils rejected the proposal as not being representative of the feelings of a majority of the airline's ALPA members.

ALPA Argues Case in Pilot Age Fight

New York—Air Line Pilots Assn. charged last week that in ruling that airline pilots over the age of 60 must retire by Mar. 15, the Federal Aviation Agency made the "judicial" decision of a court without holding a formal hearing or following the procedural rules of "due process."

ALPA was seeking an injunction to bar enforcement of the FAA age ruling and a declaratory judgment to invalidate it (AW Feb. 1, p. 33). Oral arguments were concluded in U. S. District Court for the Southern District of New York State before Judge Alexander Bicks, who reserved decision. His decision is expected to be announced in early March.

Henry Weiss, counsel for ALPA, argued that the FAA decision, reached in December, impinged on or limited the "license rights" of about 40 pilots, all of whom hold Airline Transport Ratings issued by the Civil Aeronautics Administration, predecessor of FAA.

Before these licenses could be "suspended, modified or revoked," Weiss contended, the FAA must follow the procedure outlined in Sec. 609, Title 5 of the U. S. Code. This requires FAA to give the pilots involved full notice of the forthcoming proceedings, advise them of the agency's reasoning and hold a hearing on each case. Decisions of the FAA would then be reviewed by the Civil Aeronautics Board.

The injunction case turns on the legal distinction between a federal agency's power to make rules, which is legislative, and its power to adjudicate the rights of individuals, which is judicial. Courts frequently have been asked to determine the scope and nature of these two powers after administrative agencies had multiplied and gained broader authority within the federal government.

Representing the FAA, S. Hazard Gillespie, Jr., the U. S. attorney for the Southern District of New York, maintained that the pilot age limitation was a valid exercise of the agency's rule-making power. To bring into play the provisions of Sec. 609, the FAA would have to single out an individual pilot for disciplinary action, he contended.

Since it is concerned with the safety standards of the entire air carrier industry in retiring pilots over age 60, Gillespie told the court that the FAA need only:

- **Give notice** of its intended rule by publishing it in the Federal Register.
- **Accord interested parties** an opportunity "to participate in the rule-making through submission of written data, views or arguments."

Gillespie said that the FAA had met these two requirements. The administrator's decision, therefore, could be set aside only if it were proven "arbitrary and unreasonable." To answer ALPA's contention that the ruling was in fact arbitrary, Gillespie said that:

- **Incidence of sudden strokes** and heart attacks climbs sharply in men over age 60.
- **Number of pilots** age 60 and above is steadily increasing. In his written brief, Gillespie stated that there were no airline pilots in this age bracket during 1947. Currently, "about 35" are flying. By the end of 1960 there will be 47, and by 1962 there will be "more than 80," the FAA attorney said.
- **Older pilots,** by virtue of their seniority, are in command of "choice flights." Often jet powered, these trips carry more passengers at faster speeds with attendant increases in responsibilities for their pilots.
- **Piloting of a jet transport** demands greater manual dexterity and motor coordination than does the piloting of a piston-driven aircraft. These functions, FAA contends, deteriorate with age.

Under the FAA ruling, pilots older than 60 could still fly what the agency terms "non-common-carrier runs." FAA has not defined precisely what these would include, but its attorneys told AVIATION WEEK that these pilots probably would not be banned from ferry missions and check flights.

ALPA's anti-retirement argument, which frequently was interrupted by questions from Judge Bicks, centered on the contention that FAA's ruling was aimed at the pilot group and not at the industry's over-all safety standards. Asked from the bench if the case at hand did not represent a conflict between approximately 40 pilots and America's traveling public, ALPA counsel took sharp issue, stressing that air safety was not involved because:

- **There is no evidence** to establish a correlation between the age of a pilot and any given accident or series of accidents.
- **The senior pilots** had received thorough physical examinations semi-annually for "over 25 years." This gives any examining doctor an excellent picture of their condition and makes the pilots "the most select physical group in American industry" despite their age.
- **The "lightning-fast" reflexes,** which popularly are associated with the profession, are desirable only in flying fighters. Emergencies that crop up in airline flying require and allow time for the pilot to think before taking action.

ALPA also suggested that the FAA administrator, in promulgating the age limitation, knew that he was "adjudicating rights" of government licensees and not rule-making. Placing of the limitation in Part 40 of the Civil Air Regulations, which contains general operating rules governing the air carrier industry, rather than in Part 29, which sets the physical standards for airmen, proved this, ALPA attorney Weiss told the court.

Historically, he said, physical disqualification to fly has been made on an individual basis without an upper age limit that would force retirement.

Aeroflot Reports Gains

Moscow—Aeroflot has disclosed some of the sharp traffic gains achieved on specific routes last year as a result of new or improved jet and turboprop service.

Passengers flown from Moscow to Leningrad climbed from 4,239 passengers in August, 1958, to 26,678 in August, 1959. Southbound traffic from Leningrad to the Russian capital rose almost 12-fold—from 2,113 to 24,599. The hundred-passenger, twin-jet Tu-104Bs, introduced on the route last Apr. 15, were largely responsible for these gains.

On the Moscow-Kiev and Moscow-Tbilisi routes, airline passengers during 1959 exceeded the totals for 1958 and 1957 combined. Traffic from Moscow to Tashkent, Alma-Ata, Baku and Simferopol in the Crimea doubled last year. Aeroflot said that trans-Siberian air traffic also made substantial gains—especially on the Moscow-Khabarovsk link.

BOAC Seeks 40% Of Atlantic Market

London—British Overseas Airways Corp. plans to expand its share of the North Atlantic air travel market to more than 40% this year and to about 45% by the summer of 1961.

Main factor in this expansion will be BOAC's Boeing 707-430 fleet, which will be complete by 1961. Utilization of the 707s will be 11 hr. a day, and the Bristol Britannia turboprops which back them will be used almost as much. Thirty 707 scheduled flights and 14 Britannia scheduled flights will be operated on the London-New York route. De Havilland Comets will not fly this route.

BOAC's share of the North Atlantic market as a whole has shown steady growth over the past few years. In 1951 it was 31%; in 1958, 35%; in 1959, 38%. This year it is budgeted at more than 40% and next year it is expected to reach the mid-40% level.

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3. To the conduit that carries the high frequency cable through the massive concrete wall.

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The selection of Styroflex® air dielectric cable for use in the missile field was based on its superior electrical properties, uniformity, rugged physical qualities, long lengths that can be pulled up a tower without splicing and the elimination of radiation always present in braided coaxial cables. ■ Already proven in scores of applications, including broadcast, radar, missile tracking and tropospheric systems, Styroflex® cable has a long record of successes since its introduction in Europe in 1937. ■ Next time you have requirements for a high frequency cable with low attenuation and an extremely low inherent noise level, check the qualifications of Styroflex®. Just write Phelps Dodge.

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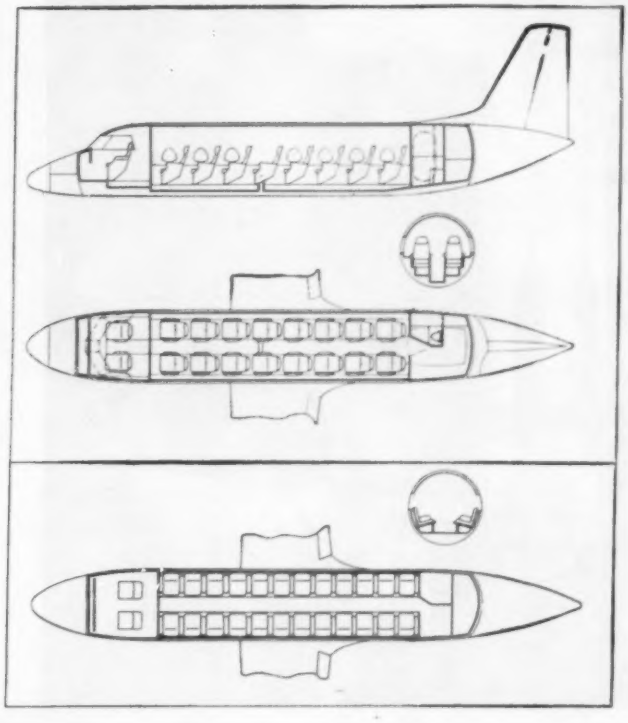
4. Here, the Styroflex® cable from the blockhouse enters the lower deck of the Titan launch Complex 16

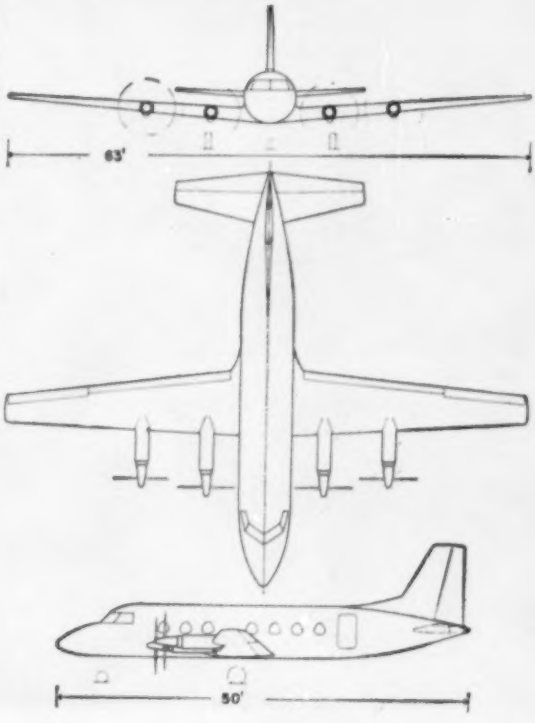
5. Then begins to rise perpendicularly through the lower portion of the launch deck . . .

6. Climbs the side of the umbilical tower and helps send The Martin Company's Titan on a fast trip over the Atlantic Missile Test Range!

Potez Air-Fouga P.840 Designed for Feederlines

Artist's conception of Potez Air-Fouga P.840 feederliner (AW Dec. 14, p. 50); plane is powered by four Turbomeca Astazou turboprops and will carry a 5,300 lb. payload some 625 mi. at 300 mph. cruise speed. First flight is scheduled by end of 1960. Company is building the prototype with its own funds. Low and high density seating is shown below; note longitudinal arrangement at bottom.





SHORTLINES

► **Allegheny Airlines** reports that over 15,000 passengers have flown the carrier's experimental "commuter" flights between Philadelphia and Pittsburgh since the service was inaugurated last Oct. 4. Of the total, 4,500 took advantage of Allegheny's special no-reservation fare at a 35% discount.

► **Federal Aviation Agency** has assigned three research and development specialists to the British Ministry of Aviation for two years. British are sending a four-man team to the U. S. as part of an information and personnel exchange program. The United Kingdom team will be assigned to FAA's National Aviation Facilities Experimental Center at Atlantic City, N. J.

► **KLM Royal Dutch Airlines** has begun operation of a weekly Lockheed Electra turboprop flight from Amsterdam to Baghdad via Budapest, Athens and Beirut.

► **North Central Airlines** has applied with the Civil Aeronautics Board for routes that would extend the carrier's operations into Wyoming. North Central wants to operate a route from Minneapolis/St. Paul to Casper, Wyo., with five intermediate stops in cities in South Dakota.

► **Northwest Airlines** plans to train its Douglas DC-8 turbojet flight crews at Seattle/Tacoma International Airport beginning this spring. One DC-8 will be used on a full time basis to check out 32 crews initially.

► **Trans-Canada Air Lines** has received authority from the Civil Aeronautics Board to extend its Halifax-Boston route to New York and to use the latter city as a co-terminal point on the airline's Halifax route which also serves St. John, New Brunswick, and Yarmouth, Nova Scotia. The Canadian carrier also will be allowed to operate charter flights on an off-route basis. Trans-Canada reports it moved 3,693,000 lb. of air freight in and out of Vancouver, British Columbia, during 1959.

► **Trans World Airlines** plans to begin nonstop Boeing 707 Intercontinental turbojet service from New York to Rome on May 27. The flights will continue on to Athens for the first jet service between the U.S. and Greece.

► **UAT French Airlines** is scheduling all-cargo service between Paris and Dakar, French West Africa. UAT will operate on a once a week basis using Douglas DC-6B aircraft.

AIRLINE OBSERVER

► Boeing Airplane Co. has laid out designs for a long-range high gross weight version of the 707 designated the 707-520 for West Coast-Europe and New York-Moscow routes. Grossing some 340,000 lb., the plane will carry at least 30 more passengers over these routes than the current intercontinental 707. Production of the plane, which will be powered with new Rolls-Royce or Pratt & Whitney turbofan engines of 22,000 to 24,000 lb. thrust, will be dependent upon firm orders received.

► **Pan American World Airways has signed a three-year agreement with Pakistan International Airlines for the lease of one Boeing 707 intercontinental jet transport to be used on PIA's London-Karachi route. Pan American will handle all maintenance and provide flight crews for the operation of the aircraft until PIA has checked out its own crews. Once weekly service with a plane drawn from Pan American's jet "pool" is scheduled to begin Mar. 7.**

► American Airlines and aircraft dealer Frederick B. Ayer and Associates are completely renegotiating their contract for disposal of the airline's Douglas DC-6 equipment (AW Apr. 27, p. 24). Over-all contract involved 75 of American's Douglas and Convair airplanes. Ayer already has sold or leased four DC-6 models and 23 Convairs.

► **Market for Douglas DC-3s may not weaken as rapidly as originally expected since new routes and growing traffic volume are requiring local service carriers to maintain and even increase the size of present DC-3 fleets despite the addition of more modern aircraft. Lake Central, for example, has taken an option on two additional DC-3s which it will continue to operate after five Convair turboprop 340s now on order are scheduled into service.**

► Avionics manufacturers are expected to move quickly in the development of new miniature pictorial cockpit displays for use in transport aircraft as a result of recent operational evaluation tests by the Federal Aviation Agency which confirm that such displays are extremely useful in easing traffic control problems. Displays will show aircraft position relative to the chart of the area, using Vortac bearing and distance information.

► **American Airlines reports these statistics: only 7% of all trips 200 mi. or more were made on commercial airlines last year. Only 22% of the U.S. population has ever taken a trip on domestic airlines, 15% of all air travelers took 64% of all air trips. It is estimated that 88% of all flights will be made this year by travelers who have flown before. This figure, American says, may drop to 80% during the next two to three years.**

► Display consoles designed to indicate collision courses in time to prevent midair accidents are being built by Stromberg-Carlson Division of General Dynamics Corp. as subcontractor for General Precision Laboratories. Units will be installed at Federal Aviation Agency's experimental control center at Atlantic City, N. J.

► **Britain's Minister of Labor will establish a tribunal to consider working conditions for pilots flying de Havilland Comet turbojet transports. British Airline Pilots Assn. and British European Airways have been unable to reach agreement on new working conditions. Pilots want a rearrangement of schedules to cut the working day to 10 hr.**

► Boeing Airplane Co. is now moving a 707 turbojet transport out of its Renton, Washington, plant every three days and has 15 major and final assembly positions in the 707 line.

► **Cutback of Convair 880 jet orders in South America has resulted from economic problems experienced by airlines in that area. Transcontinental S. A., the Argentine private enterprise carrier with a route to New York, has dropped its order for four 880s for 1961 delivery. Real Airlines of Brazil has reduced its order of four 880s to three, with delivery scheduled in July, 1961.**

For the eyes of the Pentomic Army

Advanced Honeywell will guide high-performance

Smallest, lightest unaided inertial system will direct complex flight path over enemy territory for scanning, mapping and pinpointing targets, and return drones to recovery area.

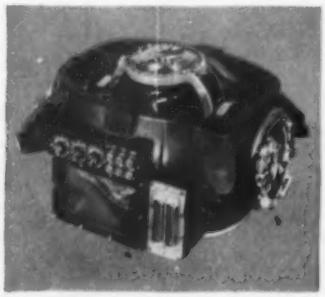
The new theories and techniques of warfare call for missions that can be carried out only by combat surveillance drones that are increasingly sophisticated and recoverable for use again and again.

Under the guidance of the U. S. Army Signal Corps, Honeywell is providing for the newest of these unmanned aircraft the most advanced, versatile and accurate *miniature* inertial guidance system yet developed. The system enables programming to provide surveillance over several areas during each flight, and safe return of the drone to the recovery area.

Although missions include reconnaissance and mapping, the most important is target pinpointing. Here it is necessary that the inertial system of the drone be extremely precise, since the target-position information the drone gathers is utilized by the inertially-guided ballistic missile which is fired on the target. Honeywell achieves such precise performance characteristics through the use of an advanced miniature integrating gyro and pulse-torqued accelerometer.

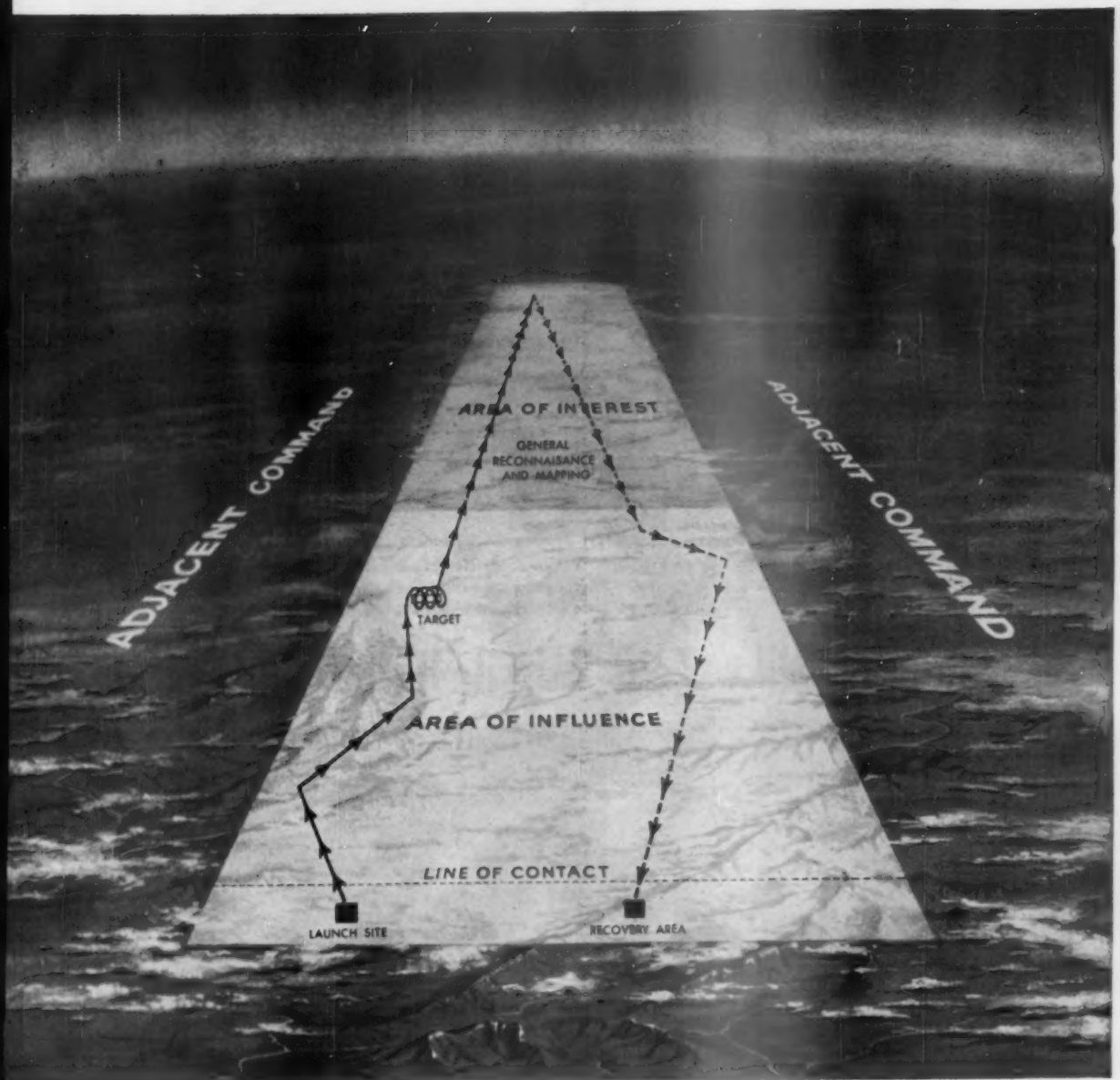
Both vehicles—the AN/USD-5 (Fairchild Engine and Airplane Company) and the AN/USD-4 (Republic Aviation Corporation)—will accomplish separate missions using virtually the same Honeywell inertial guidance equipment. The heart of this system was designed for adaptability to other navigation and stabilization requirements for Army surveillance, as well as to other inertial applications that include developments for the Centaur Space Probe and the Bomarc Interceptor Missile.

Honeywell's program management approach and experience in development and production of similar equipment on several programs results in precise miniature inertial systems for less cost than is customary in the industry. For additional information on Honeywell's background in inertial guidance and navigation, write to Honeywell, Minneapolis 8, Minnesota.



Inertial platform, heart of the inertial guidance system. This platform is the inertial reference and utilizes a highly precise GG8001 Honeywell gyroscope and GG116 pulse-torqued accelerometer.

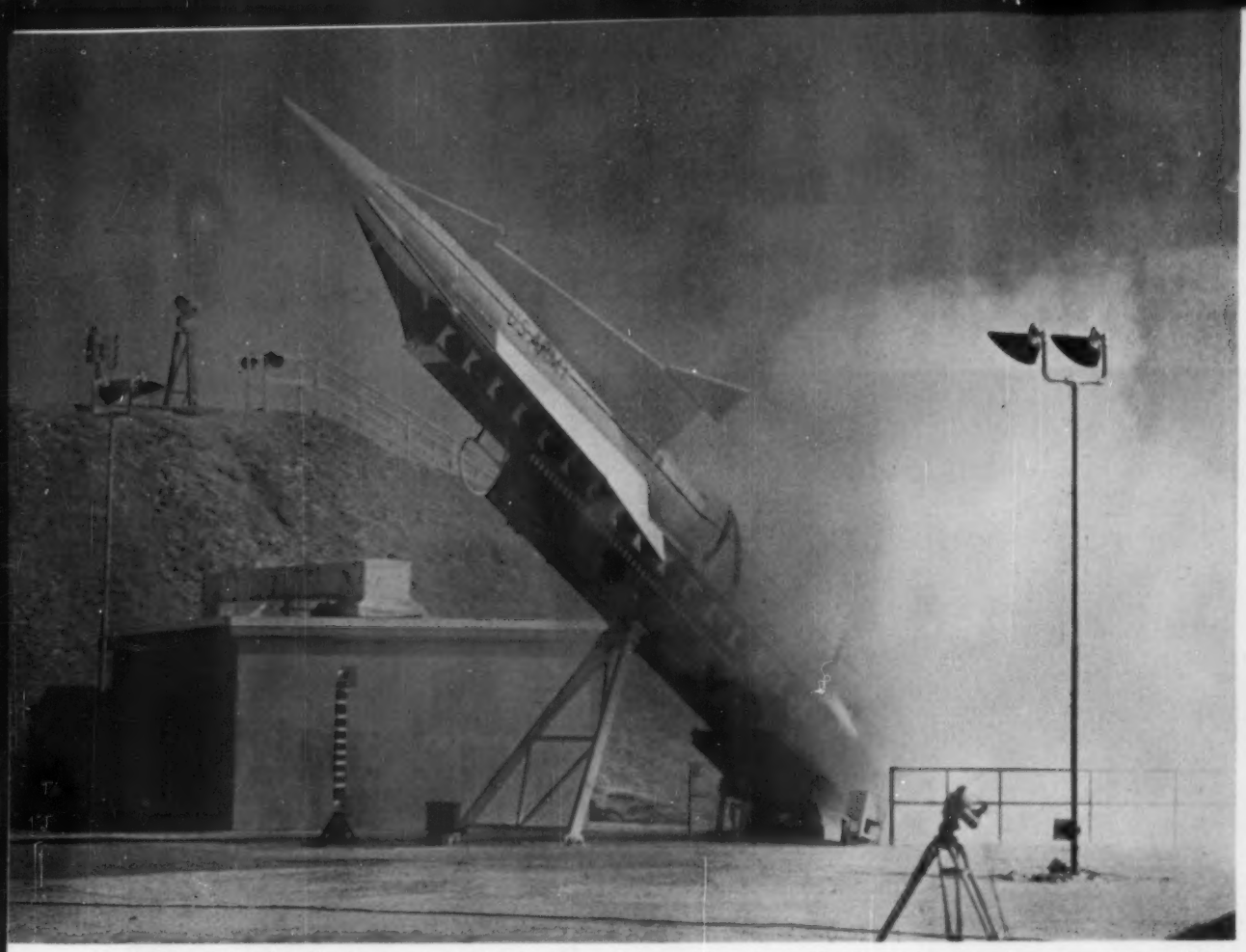
Miniature Inertial System surveillance drones



Flight path programmed for a typical advanced-drone mission is shown in this diagram. The Honeywell miniature inertial guidance system will direct the aircraft from launch to target and beyond, and back to recovery area without ground commands.

Honeywell

Military Products Group

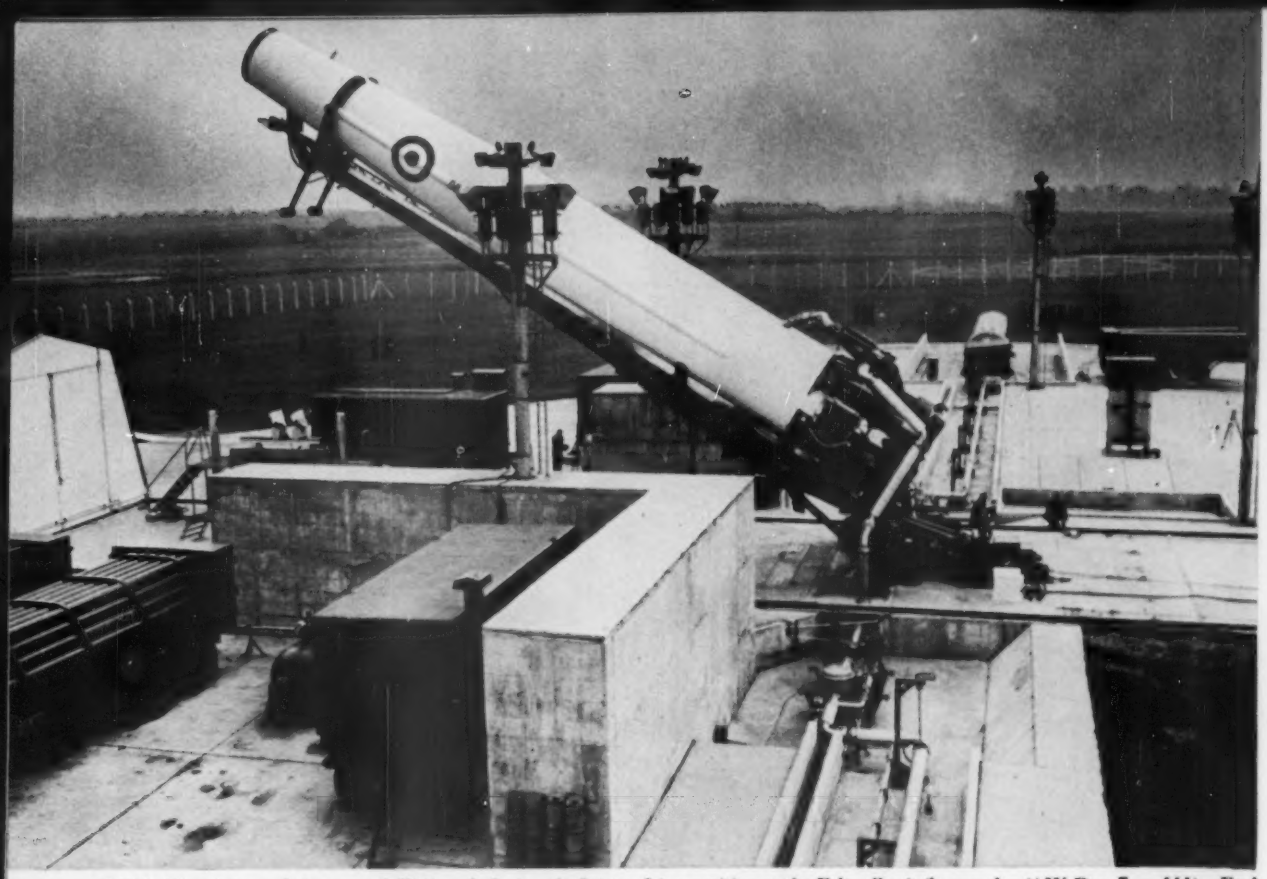


Fourth firing of Douglas Nike Zeus surface-to-air interceptor missile at White Sands (N. M.) Proving Ground was termed successful; first was a failure, second was successful and third partially successful. Projections on forward fin tips are insulator caps for antennae for radar signals. Tactical firing angle would be near vertical and from an underground launching cell.

Douglas Nike Zeus Missile Fired Successfully

Nike Zeus Thiokol booster (450,000 lb. thrust) contains solid propellant fuel; sustainer was developed by Grand Central Rocket Co. Douglas supplies the inert parts of the rocket engines, such as cases and nozzles. Purpose of the test flights is to explore in-flight operation of the rocket motors, high temperature structural conditions, component data and aerodynamic information.

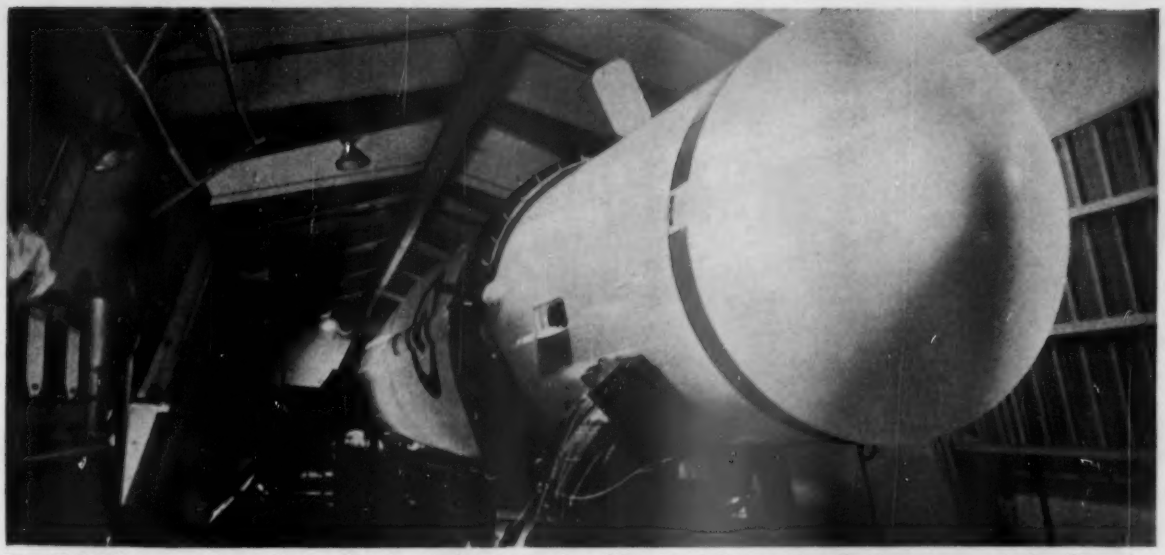
at White Sands Proving Ground



British Thor intermediate range ballistic missile is raised into firing position at the Feltwell missile complex (AW Dec. 7, p. 111). Fuel pipes are at the right foreground and nitrogen bottles are located at the left. Oxygen tank is at upper right, behind the missile. To date, only the Feltwell and Driffield complexes have been identified; both are about 110 mi. apart on the east coast of England.

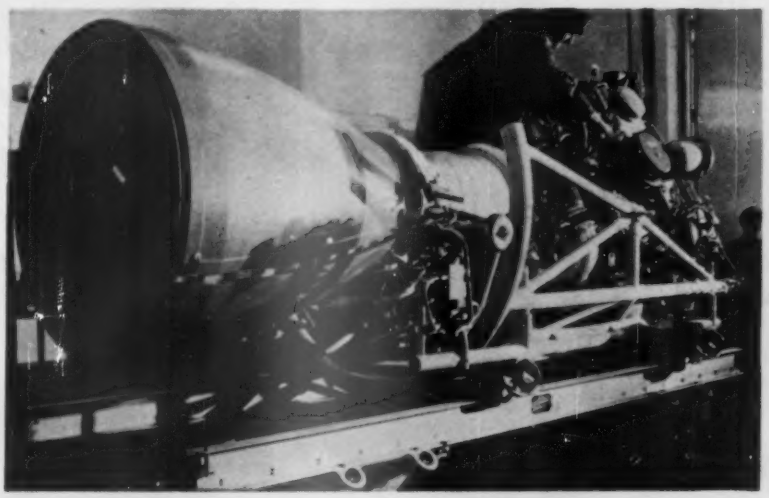
Fourth British Thor Site Nears Operational Status

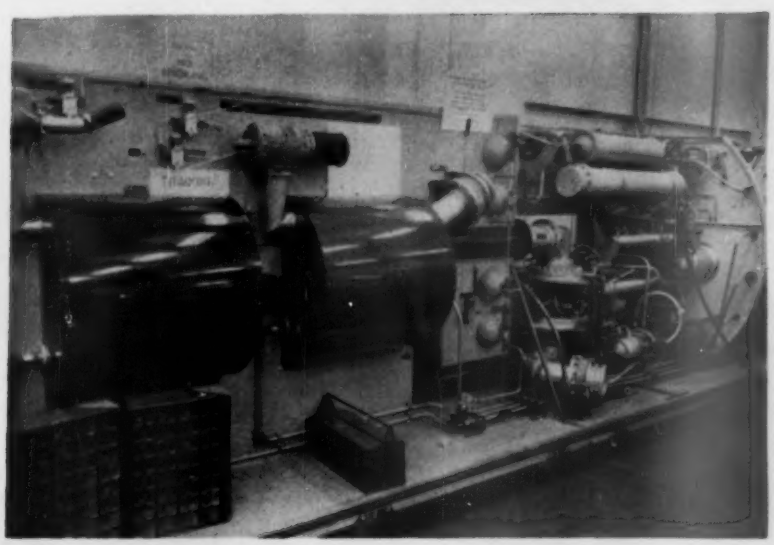
Royal Air Force officer and airman are on duty in the Feltwell Thor monitoring van (below, left). The control van is at lower right. Each of the four British complexes house major servicing equipment and facilities for inspection and maintenance of the IRBMs. Cost of maintaining a Thor on its launch pad approximates the cost of maintenance of one British V-bomber. The missiles are normally held at 15-min. readiness but this period can be reduced.

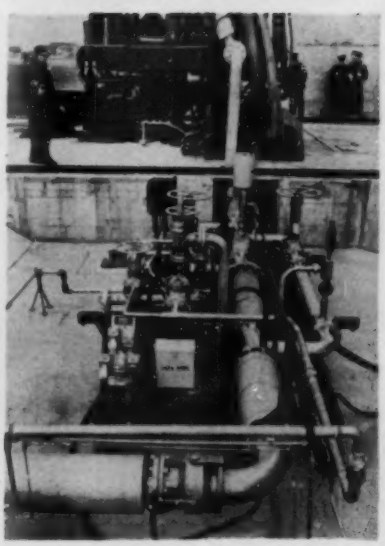


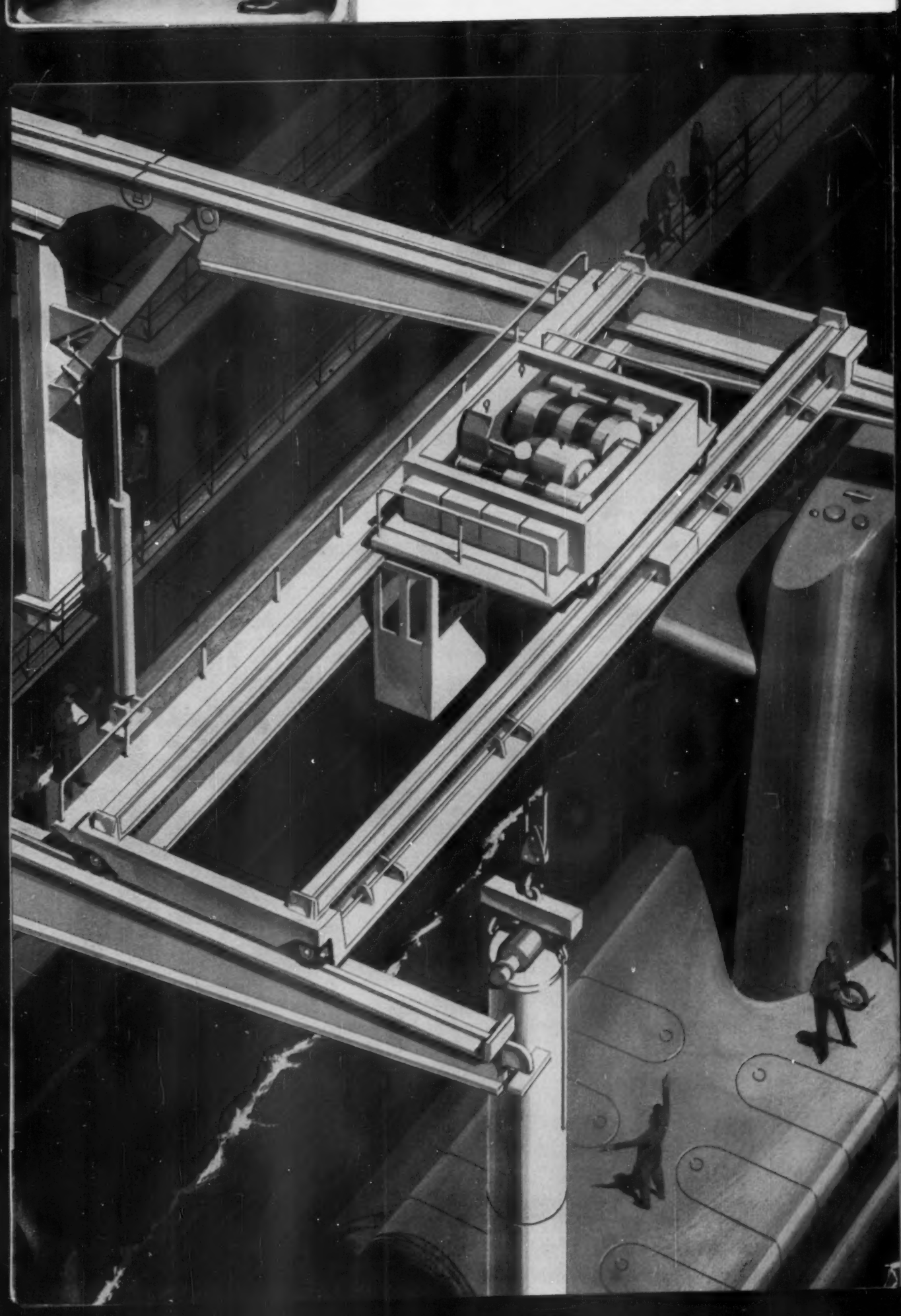
Thor IRBM lies prone in its weatherproof shed on the launch complex. Note electrical connections fitted to nose as part of readiness state and checkout. Each complex consists of five squadrons, dispersed at satellite sites 12 mi. apart.

Rocketdyne powerplant for the Thor IRBM undergoes inspection by an RAF technician (right). Mockup of the engine and its related systems is detailed in a mockup used for classroom work (lower left). At the lower right is closeup of the fueling trenches, located just below the actual launch pad. Site work on last of four British Thor sites was completed Jan. 28 and the base should be operational by mid-year. The 45 missiles deployed at the other three complexes already are operational. All the complexes are located on the east coast of England in flat countryside areas; all are sited on existing RAF bases. Total strength is about 4,000 men, about one-fifth the total strength of RAF Bomber Command. Three launch pads at each satellite are spaced a few hundred yards apart and are crewed by a total of 14 men per missile.









Threading the needle with a POLARIS missile using Westinghouse Load-O-Matic controls

Easing POLARIS missiles from a tender into the launching silo of an atomic submarine takes a handling system that combines ruggedness with extreme maneuverability and safe, sure, precision control—control so sensitive that the POLARIS seems to float in the air as it swings smoothly and gently into position in the submarine.

Westinghouse Load-O-Matic* crane control system was selected by Skagit Steel and Iron Works[1] for this exacting and delicate handling operation because of its unerring vernier precision performance. The combination of hoist, bridge and trolley controls operating with almost microscopic accuracy nullifies the pendulum-like swaying of the load. These positive, stepless speed controls provide movements at less than one foot *per minute*, yet will accelerate smoothly up to two feet *per second*.

The exclusive Westinghouse features which permit such precision also provide maximum reliability and minimum maintenance. Static controllers, saturable reactors and magnetic amplifiers provide stepless control and eliminate moving parts, mechanical relays and switches which corrode, wear out and require frequent maintenance. The marine-insulated a-c wound rotor motor adds additional reliability and further reduces maintenance.

Whatever your requirements for missile handling equipment—drive systems for launchers, erectors, shelters, loaders, or shockproof equipment for hardened sites—take advantage of the Westinghouse engineering knowledge, experience, range of products and unit responsibility for any type of electromechanical system. Contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

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At speeds up to 24,000 RPM precision rotor bearings in inertial guidance and navigational systems are highly critical components. Early research and development in design and manufacturing at New Departure is solving the problem and thus winning vital roles for N.D. integral rotor bearings in missile projects. For example, "B" Series bearings with separable inner ring developed by N.D. are helping set performance records in such inertial guidance systems as the AChiever.

New Departure is also supplying high-precision rotor bearings for the inertial guidance system in Polaris.

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USAF Refines Support for RAF's Thors

USAF-Douglas Thor intermediate range ballistic missile are now operationally deployed at sites in Britain, and Air Materiel Command's San Bernardino Air Materiel Area (SBAMA) has assumed prime depot function for the weapon system.

British Air Minister George Ward told the House of Commons, "As a result of test firings which have taken place in the United States, and in light of the progress made in the training program, we are now satisfied that Thor is able to take its place as part of the operational front line of the Royal Air Force."

Within Thor's 1,500 naut. mi. range are not only the major Soviet cities of Moscow, Kiev, Smolensk, Minsk, Petrozavadsk, Murmansk, and Leningrad, but nearly all of the Communist-dominated countries of Western Europe which may serve Soviet aggression moves.

Circular error probability (CEP), or that distance by which the warhead may miss the target, is described by the Air Force as being less than the radius of destruction of a hydrogen warhead. Obviously, every missile won't land within the CEP because over-all system reliability, while demonstrably high, is less than 100%. Referring to Thor, Air Force Chief of Staff Gen. Thomas D. White has declared, "As recently as a year ago, 50% reliability was considered a sound and attainable objective. Today we are attaining a capability on the order of 80%."

Basis for the accuracy and reliability figures are the results of firing 40 Thors with initial operational capability. Preceding the 40 firings were 18 test vehicles which have been launched from Cape Canaveral, Fla., since Jan. 25, 1957.

Space Booster Data

Additional reliability data has been afforded by the use of Thor in 23 applications as a space booster. While not providing data on the working of the complete weapon system, booster applications have added to the background of information on the engine and flight control system operation. Of the 23 boosters, nine have been for Project Discoverer, three for Thor-Able, three for Thor-Able I, six for Thor-Able II, one for Thor-Able III, and one for the Transit navigation satellite.

Thor now has a total of 81 launchings including space booster applications, and the recent launch of an improved Rocketdyne MB-3 Block II engine of 165,000 lb. thrust.

RAF crews are in a continuous state of readiness training and conduct regularly scheduled countdowns, both fueled and dry. To prevent an inadvertent launch when undergoing fueled countdowns, igniters are removed from the engines.

Although the British missile sites are entirely RAF-manned, a USAF officer is on 24 hr. call to release a nuclear warhead if such an order would ever be transmitted. Orders for activating the warhead, which would be the job of this USAF "authentication officer," would come from the President by coded message over a direct line with Strategic Air Command headquarters in Omaha, Neb.

The presence of the USAF officer largely is symbolic since the nuclear warheads already are mounted in the nose cones of the missiles, ready to go. Need for authentication could be circumvented in the electrical system, but both USAF and the Royal Air Force are operating on the understanding, backed by close ties, that each will adhere to a standing agreement (AW July 13, p. 29).

Support for the Thor program in the way of spares and operational improvement will come from the Air Materiel Command's San Bernardino Air

Minuteman Complex at Cape Canaveral to Be Finished This Year

Blockhouses at Minuteman launching complex at Cape Canaveral, Fla., will be covered with sandbags. Site also includes two launching pads and two underground silo launchers. Assembly and fuel storage facilities for Minuteman will be located at a different site at Cape Canaveral. Blockhouses, 50 ft. in diameter, have walls 4 ft. thick. Minuteman complex will be completed this year.

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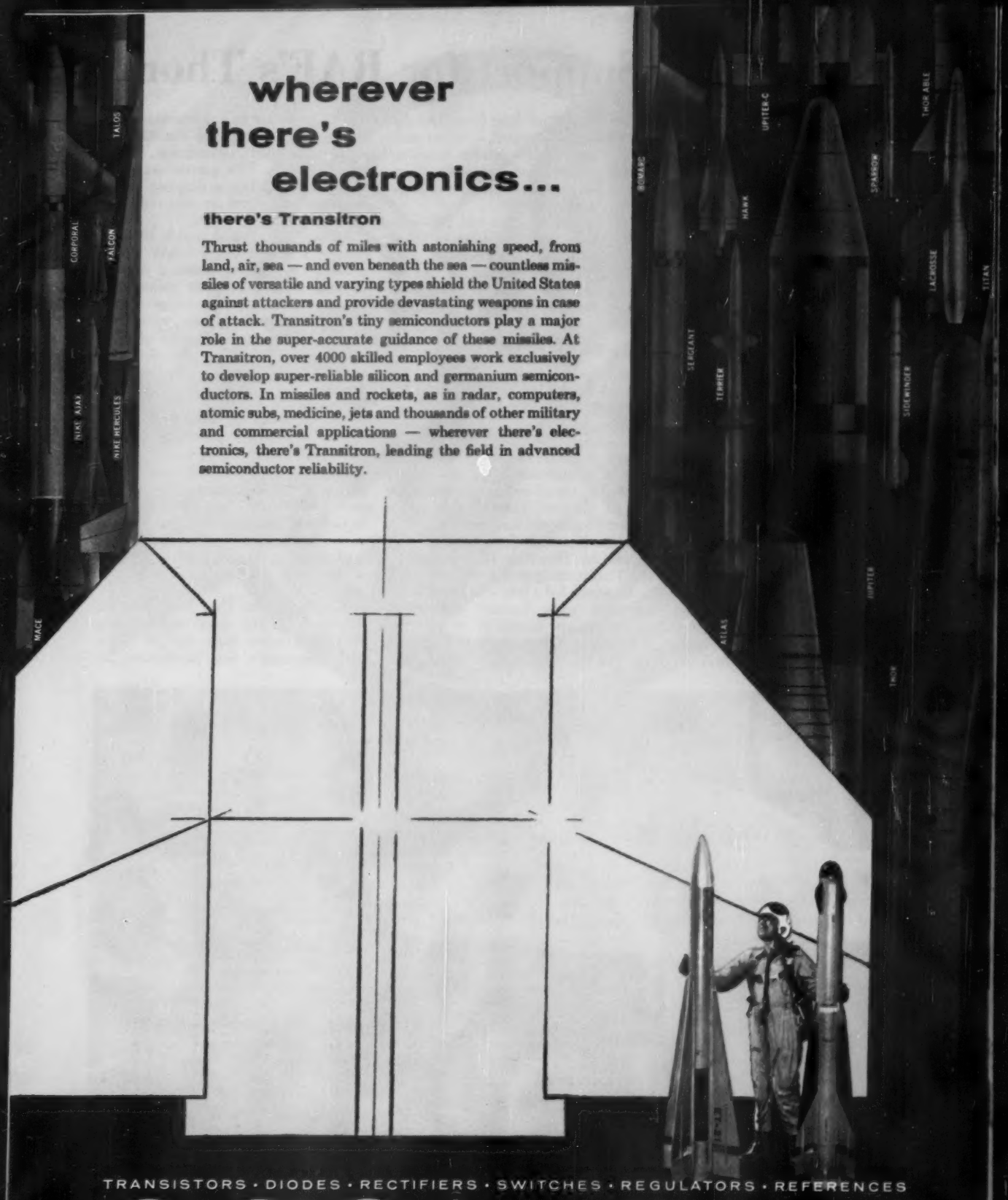

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Materiel Area at Norton AFB, Calif. Thor personnel now are in the process of being absorbed in other weapon system projects. Experience gained on WS-315A will be applied to other programs. Lt. Col. Sydney Green, third program director for Thor, has already been assigned to a new program.

Storage Units

Aside from the Thor missile itself and its transporter-erector, a complex consists of storage units for fuel, liquid oxygen, gaseous oxygen and nitrogen, electrical power-generating equipment, a hydraulic pumping unit, trailer-mounted launching countdown group and checkout station, plus the wiring and piping which ties the units together.

One of the major equipment items is the special semi-trailer transporter-erector designed to carry Thor. The prestressed steel spine of the trailer prevents the strain of transportation from being transmitted to the missile frame while cradling it in hydraulically positioned hold-down clamps (AW May 18, p. 74). Facilities for trouble-shooting and maintaining the IRBMs while on the operational site also were developed concurrently with the program.

RAF and USAF crews were instructed in operation and maintenance procedures at a Douglas-operated training school in Tucson, Ariz. In addition to courses covering airframe and group support equipment systems, courses were also conducted by AC Spark Plug Division of General Motors Corp. on the guidance system, and by Rocketdyne Division of North American Aviation on the propulsion system. Now that Thor has been phased out of research and development, further responsibility for training has been delegated to the Technical Training Center, Sheppard AFB, Tex. A total of 1,863 RAF and USAF officers and enlisted men were trained at the Douglas school.

Operational training, still continuing at Vandenberg AFB, Calif., follows the formal classroom training. Refresher training, which calls for each crew to return twice yearly for live firings, also is being conducted at Vandenberg (AW Oct. 26, p. 69).

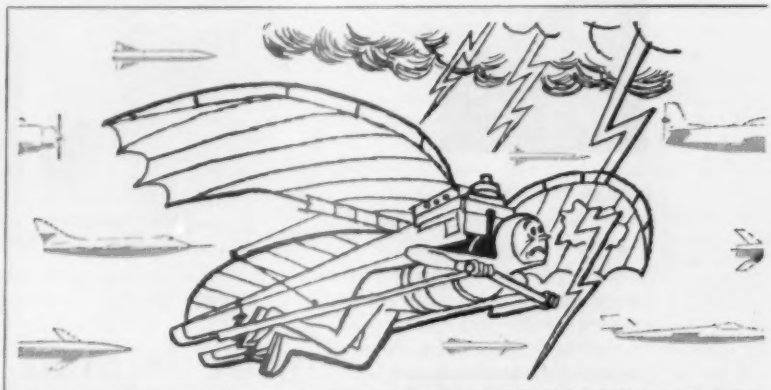
Effect of this over-all concurrency is that sufficient personnel are trained, launch sites in the United Kingdom are ready, and the Thor is an operational force in being.

Thor Logistics

Operational deployment of Thor to England has necessitated the shipment of approximately 40 million lb. of equipment, a Douglas spokesman says. About half of this has been airlifted by the Military Air Transport Service, mainly in C-124 and C-133 aircraft. Future logistic support in the form of spares and modifications is now the responsibility of Air Materiel Command's SBAMA. Until recently, Douglas was responsible for shipping USAF-purchased spares to Great Britain.

Updating of spares stock is still under study at SBAMA and Douglas. As experience is gained with the missile in the training program and in its deployment in England, spares stock system is being continuously refined, but Douglas would not comment on whether or not any particular item required replacing more often than another. Spares, they contend, are no problem and require no high degree of replacement. Mostly they are small items that are replaced on either a calendar or a cycle basis. The Douglas-maintained spares stock was transferred to SBAMA in the middle of 1959.

Future of Thor as a space booster beyond the additional 38 vehicles already funded remains indefinite. Elmer Wheaton, Douglas vice president-engineering, for missiles and space systems, foresees a use for Thor as a booster for the next five years. With normal lead time the Thor industrial complex that now exists could be kept going, he declares, with a nominal amount of production required to keep the facility alive. He would not say what this nominal figure would be.



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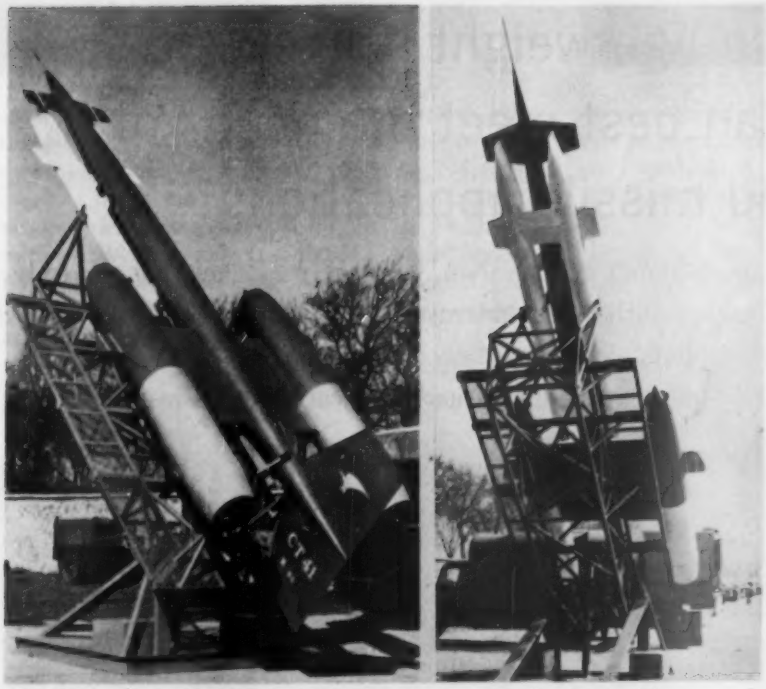


SPOILERS on outer side of each Nord CT-41 ramjet change heading on signal from ground. Canard surfaces are all-movable. Two supporting arms on launcher swing clear at liftoff.

Nord Tests CT-41 Ramjet Target

Paris—Nord Aviation is correcting flutter problems in the CT-41 supersonic target missile and is perfecting the missile's recovery sequence. Production is not expected to begin until 1961.

Hawker Siddeley Group has signed an agreement with Nord for licensed production of the CT-41; the agreement also covers maintenance of CT-41s operational with British military units.

Flight test of the target missile (AW June 22, p. 74) is conducted at the French missile test center at Colomb Bechar, Algeria.

Nord has sold about 350 units of the earlier turbojet CT-20 target missile to several North Atlantic Treaty Organization nations, and to Sweden. A pulsejet target missile, the CT-10, was another development. Nord has also sold about 40,000 wire-guided SS-10 and SS-11 missiles.

Two Boosters

The twin-ramjet CT-41, radio-controlled and recoverable, is launched by two single-stage solid-propellant boosters which burn out within 7 sec. Speed at termination of the launching phase is Mach 1.6. Maximum acceleration during launching is 10g.

Speed range of the target missile is Mach 1.5 to 2.5. Maximum endurance at Mach 2 cruise is 14 min. at 65,000 ft., 10 min. at 52,500 ft. and 6 min. at 40,000 ft.

The target's flight is controlled from the ground by an operator who can command left or right turn, climb or dive, variation of Mach number, control of supplementary equipments, and recovery. The target separates into three units during the recovery sequence, which is initiated automatically if the command link fails.

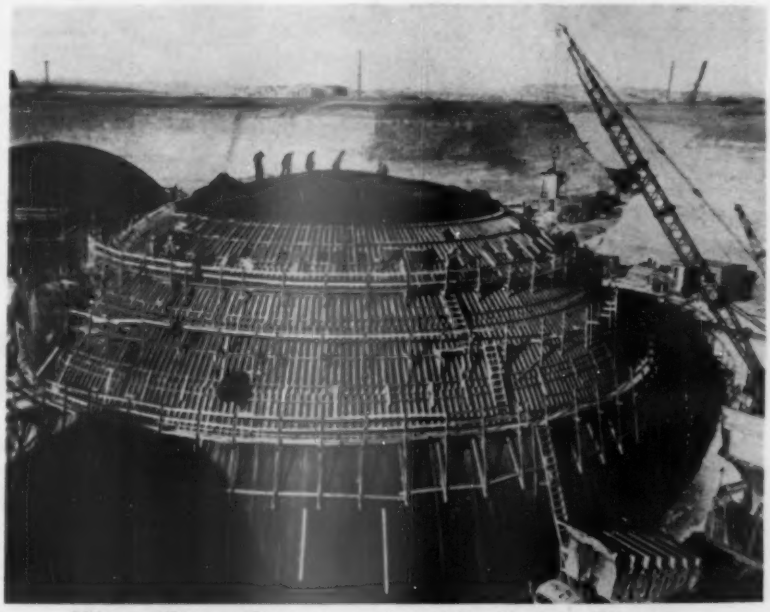
Range, altitude and azimuth data is fed to a decoder from a ground interrogator and a transponder in the target. The target is represented by a luminous spot on a plotting unit which includes a map of the locality. Data on target Mach number and altitude is given by repeater instruments. The target also can be adapted for radar tracking.

Decoy Mission

For bomber simulation the CT-41 can be equipped with X- and S-band transponders, Luneberg lenses and infrared flares. The missile eventually will be equipped with traveling wave transponders. Nord also plans to make provision for installation of equipment for measuring missile miss-distance. This equipment will include four cameras with 180-deg. coverage and a miss-distance indicator based on doppler effect.

The CT-41 has a mid-position wing, single dorsal-ventral fin and wingtip-mounted ramjets developed by Nord. Wingspan is 11 ft. 11 in., length is 32 ft. 2 in., maximum fuselage diameter is 1 ft. 8 in. and wing area is 33.26 sq. ft. The target with fuel weighs 2,865 lb. Total weight at launching is 5,620 lb.

The airframe is constructed of light alloy; only attachment fittings and miscellaneous hardware are steel. The missile can be shipped in five parts.

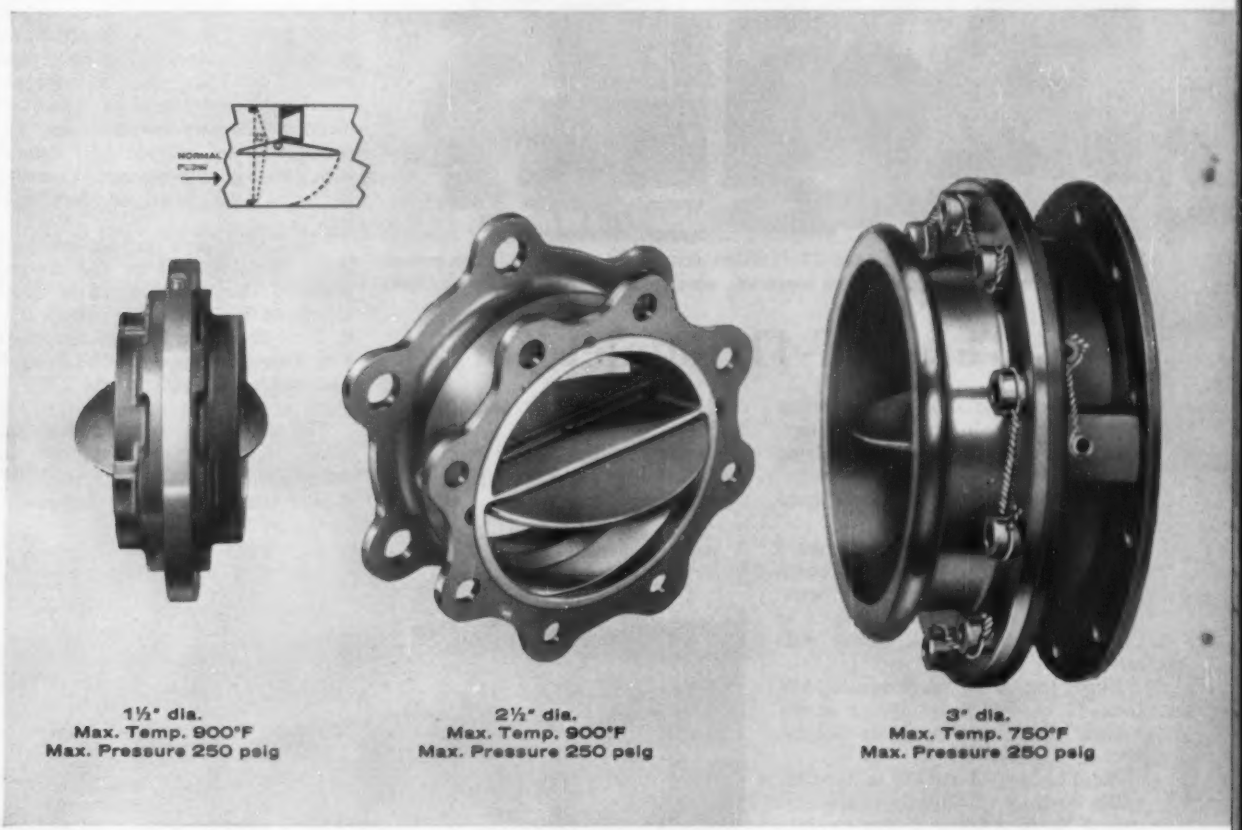


Titan Base Construction Begins at Denver

Powerhouse for Air Force's Martin Titan intercontinental ballistic missile base at Denver, Colo., is being built by Army Corps of Engineers. Concrete is poured into wooden forms.

which of these lightweight check valves by Barber-Colman best meet the needs of your aircraft and missile applications?

On your next design problem involving air check valves, you may very likely have a ready answer with a Barber-Colman valve — either in standard sizes or special sizes and adaptations developed to fit your own requirements. Wide selection of precision butterfly . . . split flapper . . . single flapper . . . and inline types for various applications, as illustrated.

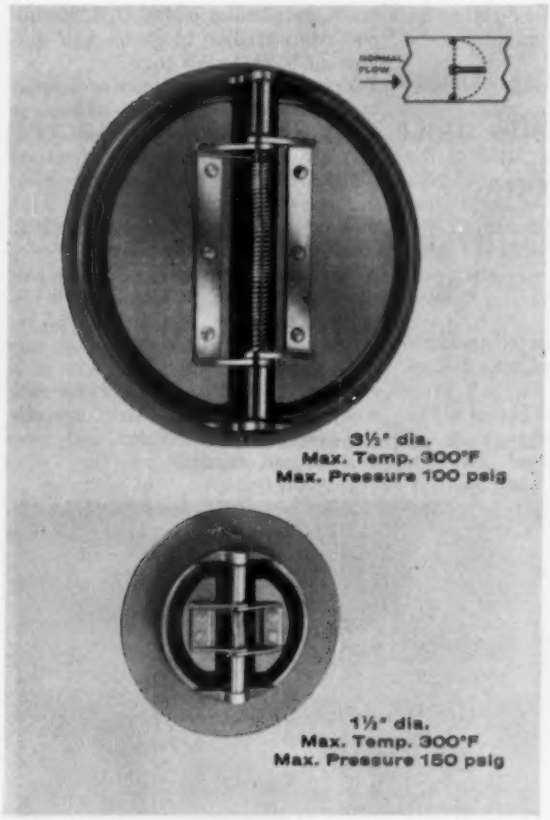


PRECISION BUTTERFLY... STAINLESS STEEL

Combining ruggedness and light weight, these Barber-Colman precision pneumatic check valves provide positive checking of rapidly reversing high-temperature, high-pressure air surges. Typical applications include use of these valves in jet engine starting systems, compressor bleed air systems for checking flow in event of engine stoppage, and controlling air flow into a wing thermal anti-icing manifold. These valves pass 10G vibration and feature extremely low leakage, low pressure drop. For a typical 2½" unit, total leakage does not exceed 0.1 lb per minute for any combination of air temperature from 80°F to 900°F and pressure from 5 psig to 250 psig. For most combinations, leakage is less. In addition to the 1½", 2½", and 3" sizes shown, others can be designed for you.

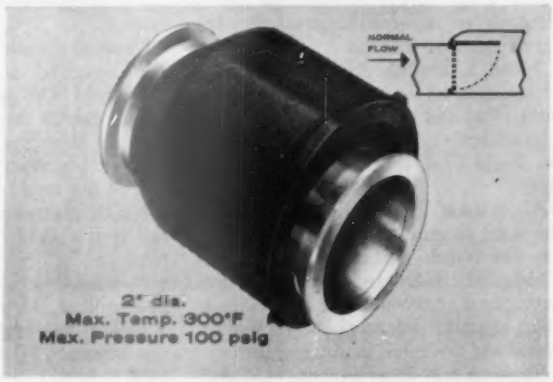
SPLIT FLAPPER

Barber-Colman split flapper type check valves are designed for a wide range of air applications employing lower temperatures and pressures. Models illustrated below are constructed of aluminum, but same general design can be produced in stainless steel for higher temperature, higher pressure applications. Standard sizes are 1½", 2", and 3½". Other sizes can be designed to your requirements. Compact, lightweight. 1½" size weighs .12 lb, 3½" size weighs .21 lb. Maximum internal leakage 1½" size: .04 lb/min . . . 3½" size, 0.1 lb/min.



SINGLE FLAPPER

An economical aluminum check valve designed for low pressure applications. Typical use is checking air conditioning system ram air. Weight .75 lb. Maximum leakage .04 lb/min at 100 psig, 300°F.



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Barber-Colman inline check valves are designed for ¼" and ½" O.D. tubing. Simple, foolproof operation, for use in servo line and similar applications. Weight, ½" size, .26 lb. Minimum internal leakage .05 lb/min.

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Defense Lists Construction Needs

Washington—More than $404 million, or 41%, of the Fiscal 1961 military construction program is earmarked for facilities to support the U. S.'s retaliatory striking capability, including support installations for dispersed manned bomber units, intercontinental missiles, Polaris fleet ballistic missile systems and intermediate range ballistic missiles being deployed in Europe.

Floyd S. Bryant, Assistant Secretary of Defense for Properties and Installations, told the House Armed Services Committee that other programs under the Fiscal 1961 construction budget include:

- **Air defense,** $168 million, or 17% of the total program. This provides facilities for North American Air Defense Command radar networks in t hemisphere, Army and Air Force missile and aircraft defenses, Navy barrier patrol and advanced countermeasures.
- **Research and development,** $152 million, or 15% of the total program. This includes $20 million for facilities for Advanced Research Projects Agency.
- **Limited war capability,** $122 million, or 12% of the total.

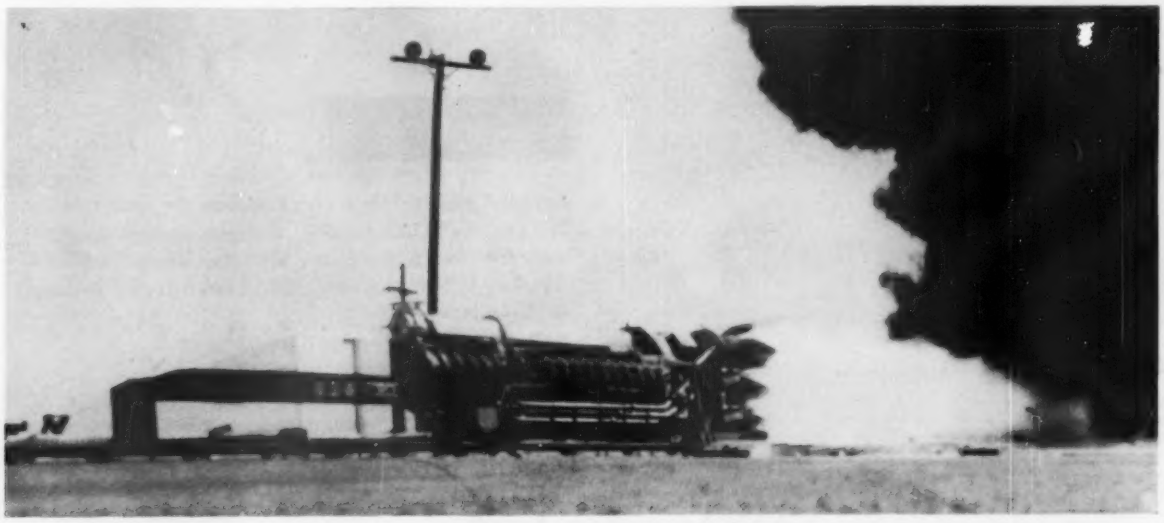
The major portion of the $972 million program for Fiscal 1961 is for the Air Force. The division is USAF, $676 million; Army, $158 million; Navy, $138 million.

Original requests of the three services, totaling $1.5 million, were first trimmed to $982 million by the Department of Defense, and then to $972 million by the Bureau of the Budget, Bryant said.

Bryant gave these details by services, on the new construction planned for the coming fiscal year:

- **Ballistic missile facilities,** $297.6 million, or 44% of the total USAF program.
- **Manned aircraft facilities** for Strategic Air Command, $68 million, or 10% of the total USAF program.
- **Facilities in support** of Aircraft Control and Warning, DEW Line stations and 41 gap filler sites, $34.3 million, 5% of the total.
- **SAGE centers** and other facilities for the system, $33.7 million, 5% of the total.
- **Bomarc interceptor** missile facilities, $26 million, 3.8% of the total.
- **Fighter interceptor** facilities at various bases, $23.2 million, 3.4% of the total.
- **Mace missile facilities** at operational locations overseas, $17 million, 2.5% of the total.
- **Research, development,** test and evaluation facilities, $17.2 million, 2.6% of the total.
- **Facilities for world-wide** communications systems, $13.4 million, 2% of the total.
- **Air Training Command** facilities, $13 million, 1.9% of the total.
- **Air Materiel Command** facilities, $10.7 million, 1.6% of the total.
- **Air Research and Development** Command facilities, $9.3 million, 1.4% of USAF's total.
- **Military Air Transport Service** facilities, $6.2 million, .9% of USAF's total.
- **Tactical Air Command** manned aircraft facilities, $4.7 million, .7% of USAF's total.
- **Research, development** and test facilities, $6.2 million, .9% of USAF's total. Army program. This includes $14.3 million for the Nike Zeus anti-missile missile project.
- **Nike Hercules, Hawk** and Missile Master facilities in the U.S. and overseas, $28.9 million, 18.3% of the total Army program.
- **Airfield and heliport facilities** at major installations in the U.S. to support Army aviation programs, $4.2 million, 2.6% of Army's total.
- **Aircraft and ship facilities** to support carrier striking forces, $16.4 million, or 11.9% of the total Navy program.
- **Polaris missile** and nuclear submarine support facilities, $13.9 million, 10% of the Navy program.
- **Research and development** facilities, $10.3 million, 7.5% of the total.
- **Missile development,** evaluation and training facilities, $8.9 million, 6.5% of Navy's total.

In addition, $17.5 million is earmarked for each of the services as a contingency fund for "facilities for new weapons developments, new research and development activities and new mission requirements."



Rocket Sled Tests Minuteman Guidance Components

Minuteman ICBM guidance components are tested at Holloman AFB, N. M., on USAF rocket sled. Type AJ10-33 sled is powered by three-chamber system supplied to USAF by Aerojet-General under a subcontract from Coleman Engineering Co. Propulsion system has a total thrust of 114,000 lb. and accelerates at 8-10g to 1,600 mph. Thrust chambers are ceramic-lined stainless steel and are not fitted with cooling equipment. They burn 4,630 lb. of propellant in 8 sec. Propellants are inhibited red fuming nitric acid and a combination of turbojet fuel and unsymmetrical dimethylhydrazine. Tests are run to calibrate acceleration-sensitive devices that measure Minuteman's velocity, and to determine environmental stability of guidance components. Without its nose section the sled measures 28.25 ft. long. It weighs 14,800 lb. fully loaded.

BENDIX REDUCES PRICES ON PYGMY® CONNECTORS!

A timely message from G. E. Steiner, General Manager,
Scintilla Division, Bendix Aviation Corporation, Sidney, New York:

As a result of our increased production volume, we are pleased to be able to announce that effective March 1, 1960, the prices of Bendix Pygmy Electrical Connectors, including those certified under MIL-C-26482 specification, will be reduced on all new orders received.

Reductions are as follows:

	% reduction
PYGMY-Standard Types (solder type contacts)	**approx. 4%**
PYGMY-CE Series (crimp type contacts)	**approx. 6%**

At a time when price increases bid fair to become the order of the day, we are taking this step toward helping to reduce military and commercial equipment costs. It is in line with our policy of always offering our customers the best product at the lowest possible price consistent with efficient design and manufacturing practice.

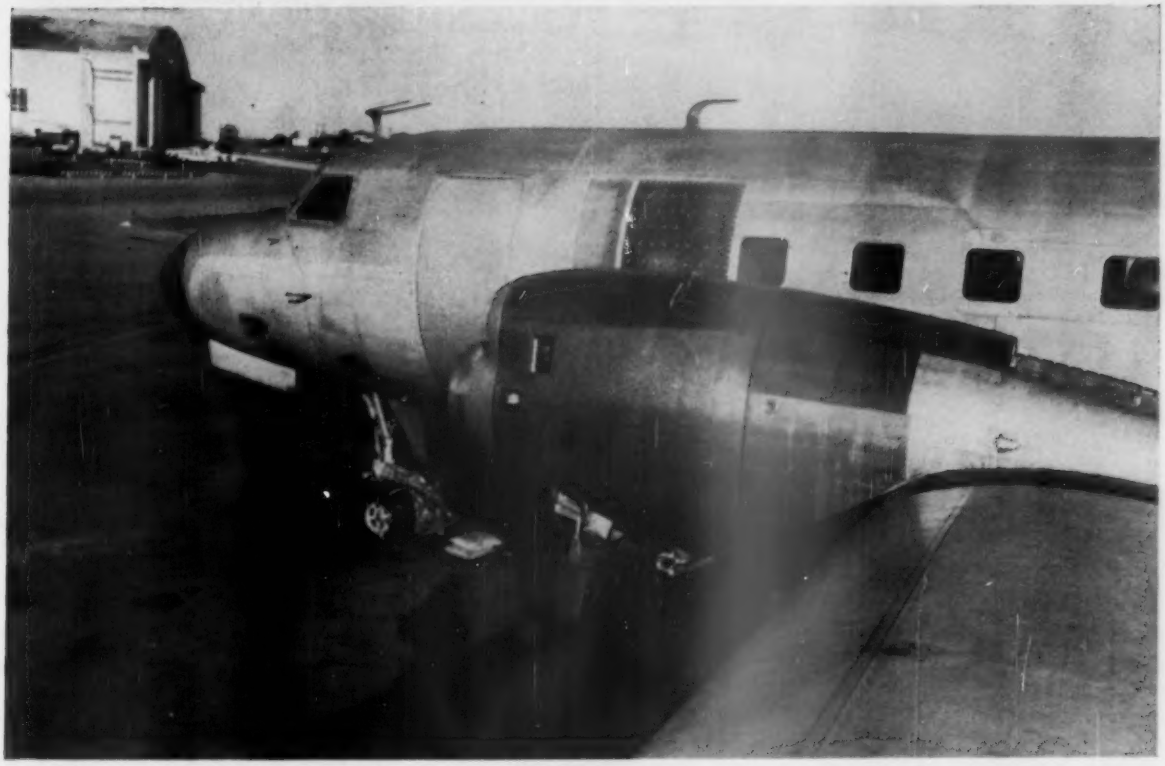
G. E. Steiner
GENERAL MANAGER

Scintilla Division
Sidney, New York

Bendix
AVIATION CORPORATION

AC Seeks and Solves the Significant—With GM's support, AC is taking giant strides toward leadership in the international technological race. And AC Reliability—characteristic of every aspect of AC's operation—plays a large role. It results in such successes as AChiever inertial guidance for Thor . . . and the more sophisticated AChiever being built for Titan. / This is AC QUESTMANSHIP. It's the scientific quest for new ideas, methods, components and systems . . . to promote AC's many projects in guidance, navigation, control and detection. / To Mr. Harold C. Yost, AC Director of Reliability, the goal of Questmanship for his group is "to find ways to make a product able to repeat its performance". They constantly seek product improvement, "making creative contributions in every area from basic design to field operation". That takes engineers with broad knowledge, imagination and experience. / You may qualify for our specially selected staff . . . if you have a B.S., M.S., or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience. If you are a "seeker and solver", write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

GUIDANCE / NAVIGATION / CONTROL / DETECTION / AC SPARK PLUG *The Electronics Division of General Motors*



CONTOUR of original Convair nacelle below thrust line is retained in conversion, as is the former firewall position.

FAA Tests Allison-Powered Convair 340

By William S. Reed

Santa Monica, Calif.—Performance capabilities of the Allison turboprop-powered Convairliner are being demonstrated here in the final series of Federal Aviation Agency certification tests being conducted by PacAero Engineering Corp.

PacAero is converting Convair 340 and 440 transports to a "Super Convair" configuration for Allison Division of General Motors Corp., which is marketing the conversions to airline operators and corporate fleet owners (AW Feb. 8, p. 41). First Super Convair delivery will be made soon after final certification, now 80% complete, with certification scheduled to be awarded Mar. 31. Test aircraft, N5100, will be retained by Allison as a demonstrator.

PacAero's manager of flight operations, L. H. Coan, demonstrated the Super Convair's performance by climbing to 20,000 ft. at the maximum gross weight of 53,200 lb. This AVIATION WEEK observer, riding in the jump seat, clocked the time-to-climb, on a day slightly warmer than standard, at 13 min. This is better than Allison's guarantee.

With the Allison 501-D13 turboprop engines at maximum rated turbine inlet temperature (MRT) of 971C, Coan released the brakes and the aircraft accelerated rapidly; rotation started at about 90 kt. Initial rate of climb exceeded the 2,000-fpm. scale of the test indicators on the panel.

True Airspeed

Airspeed stabilized at 212 kt. indicated airspeed at 20,000 ft. with an indicated free air temperature of —18C. Engines were cut back to normal cruise setting of 94% MRT (848C). Computed true airspeed with these uncorrected data is 288 kt., which compares with Allison's guaranteed standard-day TAS of 300 kt. at 48,000 lb. gross.

Following a simulated engine failure to check the automatic negative torque signal, the left propeller was feathered and the right engine advanced to maximum continuous MRT (932C). The aircraft maintained 20,000 ft. with airspeed stabilizing at 135 kt. IAS.

Acceleration from 140 kt. IAS to more than 300 kt. while maintaining 5,000 ft. altitude showed that sufficient elevator control is available to overcome the de-stabilizing effect of the increased engine horsepower. Considerable elevator trim is required as speed builds up, but increased elevator and horizontal stabilizer areas provide ample margin.

Landing weight was in excess of 50,000 lb. (certificated maximum is 50,670 lb.), hence a single engine landing was not demonstrated. Single engine landings, using full reverse thrust on one engine (80% power), have been executed repeatedly, Coan said.

At the conclusion of this flight, full reverse thrust was used on both engines, resulting in a very short roll despite the heavy landing weight. Brakes were not used.

Extensive airframe modification is not necessary since the Convair 340/440 aircraft are designed to accept the Allison turboprop's higher horsepower. Using a proven airframe is another advantage, Allison contends.

Convair spokesmen told AVIATION WEEK that some 340s now have logged nearly 20,000 hr. in airline service. The company is reluctant to predict what the service life of the airframe will be. Fatigue tests on the 340/440 structure have failed to yield a prediction after running into cycles equal to "many

PRECISION FILM RESISTORS

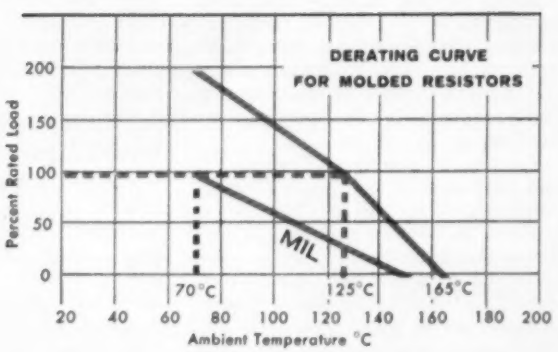
if it's news, expect it first from IRC

50% size reduction, plus improved characteristics, offered by new Molded Deposited Carbon Resistors.

IRC's Molded Deposited Carbon Resistors are now 50% smaller in size and weight, and improved in virtually every respect. The resistance element is a new extra hard deposited carbon alloy for added precision, stability and reliability. The resistance element is protected by *two* moisture resistant undercoats, both new. The case is new, heavy-duty, break-resistant. Even the terminating paint bonding cap to carbon film is a new highly-conductive type, a product of IRC research.

In short, IRC miniaturized Precision Film Resistors run cooler, withstand sudden overloads with little permanent change, and exhibit less change under load than hermetically-sealed resistors costing over 3 times as much.

MIL Type	IRC Type	Length Nominal	Diam. Nominal	Min. Ohms	Max. Ohms	Max. Volts Continuous	WATTAGE		
							MIL 70°C	IRC 70°C	IRC 125°C
RN60	MDA	.406	.130	10	5M	300	⅛	¼	⅛
RN65	MDB	.594	.203	10	5M	350	¼	½	¼
RN70	MDC	.719	.261	5	25M	500	½	1	½



IRC Molded Deposited Carbon Resistors are produced in 3 standard sizes: MDA-¼ watt, MDB-½ watt, and MDC-1 watt, and in resistances from 10 ohms to 25 megohms. Standard tolerance is ±1%, with tolerances of 0.5% and 2% also available. Write for Bulletin B9-6, International Resistance Co., Dept. 201, 401 N. Broad St., Philadelphia 8, Pa.

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thousands of hours" of inflight loads. Convair is optimistic about the life of the aircraft being equal to that of the Douglas DC-3.

Allison is prime contractor in the conversion program; PacAero's role encompasses engineering, modification, flight testing, and certification. Allison has 11 firm orders for corporate conversions of the aircraft plus five transport conversions for Lake Central Airlines, which also holds an option for 10 additional conversions.

Allison claims these conversion advantages:

• **Cruise speed increase** of 70 kt. at optimum altitude. Optimum cruise speed of a piston-powered Convair at 45,000 lb. gross is 230 kt. at 17,000 ft.; Allison-powered version, weighing 48,000 lb., will cruise at 300 kt.

• **Increased rate of climb.** Standard day climb performance of a piston-powered Convair at 5,000 ft. is 700 fpm., slightly less than 500 fpm. at 15,000 ft. Allison-powered Super Convair at the same gross will climb at 2,050 fpm. at 5,000 ft., 1,400 fpm. at 15,000 ft.

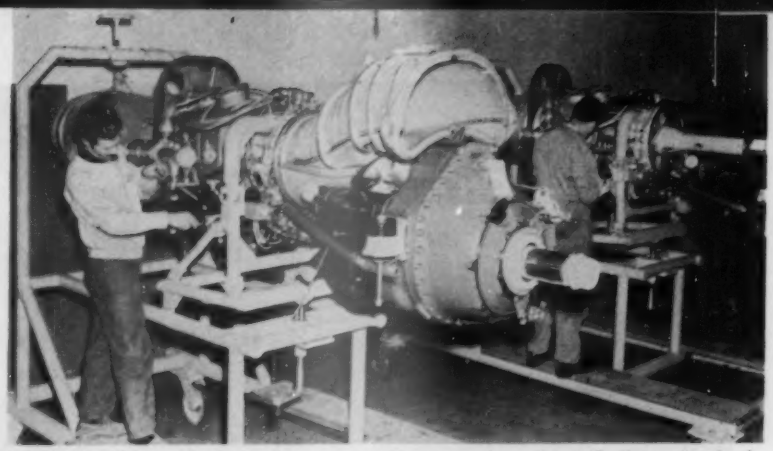
• **Over-all noise reduction** in the cabin of about 17% in the 600-to-4,800 cps. speech interference band. Noise level in the front of the main cabin is reduced from 67 to 62 db. and from 77 to 58 db. in the rear of the cabin. Normal conversation was possible in the cabin even though interior of the test plane was not finished.

• **Greater revenue-generating capacity.** Block speed comparison figures show a 28% increase for a stage length of 400 stat. mi. Allison Super Convair also will carry a 10,000-lb. payload 1,200 mi., 2,000 lb. more than the piston-powered Convair. Maximum range with an 8,000-lb. payload is almost 1,600 mi. compared with 1,200 mi. for the piston powered Convair. Maximum gross weight is increased from 47,000 lb. to 53,200 lb.

• **Lower seat mile costs.** Allison computes the cost per airplane mile of the Super Convair to be approximately equal to, or slightly less, than that of a piston-powered Convair. Typical cost on a 600-mi. stage length is $0.60/mi. for the turboprop aircraft, and $0.62 for the piston-powered aircraft. Seat mile costs can be lowered appreciably, however, because of the increased payload which will permit installation of 44, 52, 58, 66 or 77 seats. A 77-seat Convair, operating on an 800-mi. stage length, would cost about $0.68 per mi. Operating costs for a 58-seat version on an 800-mi. stage length would be about one cent per seat mile.

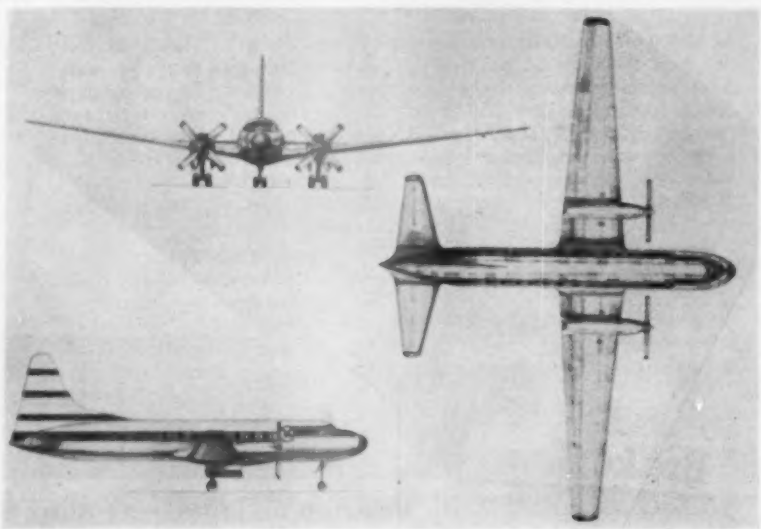
Corporate conversion configurations will have a 1,550-stat. mi. range with standard fuel capacity of 1,730 gal.

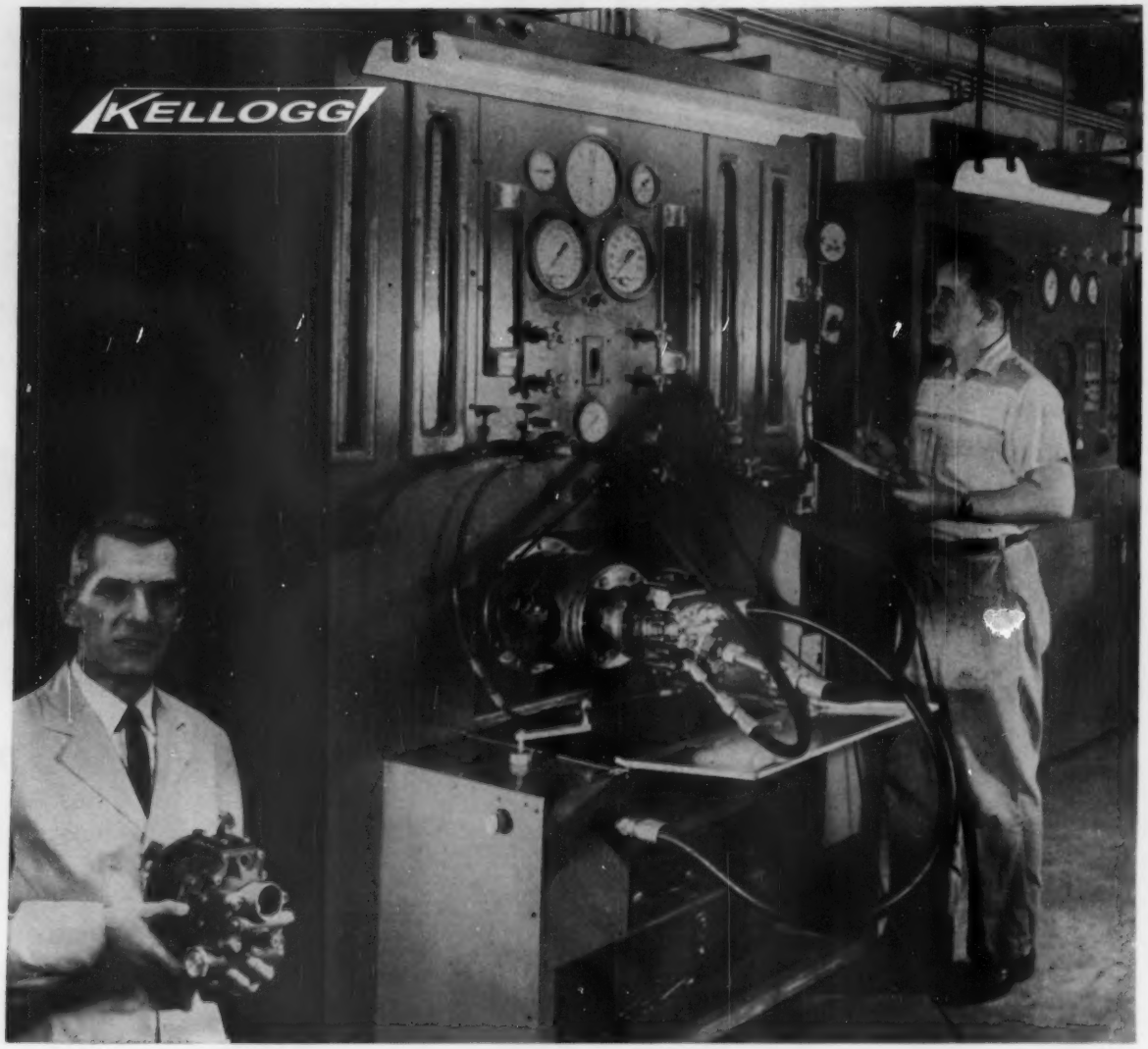
Two extra-cost options are offered to increase fuel capacity—integral wing tip



ENGINE buildup section at PacAero mounts the accessories and installs the engine in the forward nacelle section to form a quick engine change (QEC) package.

TELL-TALE warning lights are mounted in a panel just forward of radio control package and between the throttles on the center pedestal. Just above the warning panel are blade angle indicators, used for test only; space is reserved for radar scope installation in the finished airplane. Below is a three-view of the completed conversion.





*At 4 times rated pressure we gave up torturing this rugged Kellogg Hydraulic Pump**

At 12,000 psi our 100 HP drive could not stand the strain of torturing an AP6V hydraulic pump designed to deliver 3000 psi at 3750 rpm. Static pressures up to 1,000 psi were applied to the case without leakage or failure. When we took the pump apart it was in perfect condition . . . every part structurally sound.

Structural ruggedness is one of many features that add up to greater hydraulic pump dependability. Unique design of the variable stroke Kellogg pump also gives:

• Fast response. • High volumetric efficiency (over 95% at rated pressures). • Simplified design for maximum life, minimum maintenance. • Highest HP/weight ratio. • Dependable operation under rapid changes in acceleration, torque and thrust loads, and at elevated oil temperatures. • Minimum size. • Exceptional contamination tolerance.

For greater reliability in hydraulic components or systems, contact our engineering representatives, Airsupply-Aero Engineering Company, Division of The Garrett Corporation. Offices in major cities.

*Kellogg variable volume pumps range from 0.06 to 1.77 c.i.p.r., -65° to 450°F, to 5,000 psi, and to 18,000 rpm. Individual designs available for special requirements.

Variable Volume Pump Series	*Maximum Displacement Cu.In./Rev.*	*Weight Lbs.*	*Rated Speed*	*Max. Speed*	*AND Mounting Flange*
AP10V	1.77	17.5	3750	5000	10262
AP6V	1.00	13.0	6000	7300	10262
AP4V	.67	10.0	6000	7500	10261
AP2V	.38	6.5	6000	8500	10261
AP1V	.2	4.5	8000	12000	10261
AP05V	.1	2.3	12000	15000	10261
AP03V	.06	2.0	15000	18000	10260

A-4981

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tanks, which add 350 gal. and increase range to about 2,050 mi., and inboard wing tanks, adding another 820 gal. to extend range to about 2,900 mi.

Certificated performance at maximum gross landing weight is 4,300 ft. at sea level, 4,800 ft. at 5,000 ft. altitude. Allison figures that the landing performance of the aircraft is a big selling point for corporate conversions because it brings many more airports within range if instrument weather requires diverting to an alternate.

Takeoff performance also permits utilization of many fields unsuitable for pure jet aircraft. Civil Air Regulations-certificated field-length takeoff requirements for a 53,200-lb. airplane on a standard day calls for 4,800 ft. Field length required at elevation of 5,000 ft. is 6,400 ft. Hot-day performance of a 53,200-lb. airplane calls for 6,000 ft. field length at sea level, 6,800 ft. at 5,000 ft. elevation.

Allison is negotiating contracts on an individual customer basis for the conversion to turboprop power. A definite price has been difficult to establish because of many variables. For instance, the 340 aircraft needs additional soundproofing, which costs about $14,000, whereas the 440 does not. Also, the AiResearch gas turbine compressor starting unit, costing approximately $15,000, can be deleted if the operator wants to carry more payload instead of a starting unit. Eastern Air Lines, for example, uses ground starting units for Lockheed Electra aircraft.

Conversion cost is in addition to the purchase price of the airframe for operators not having Convair equipment. Residual value of a 340 on today's market is between $300,000 and $400,000, Allison says. First conversion, now receiving final touches at PacAero, is a Convair 340 purchased from Hawaiian Airlines for $350,000, minus engines and propellers. Convair reports that 200 of the 340s and a like number of the 440 series were built.

The Allison 501-D13 engines are identical with those used on the Lockheed Electra, except for minor changes. Engines are built up in a quick-engine-change (QEC) package before installation. QEC includes engine and accessories and cowling from the firewall forward.

Aeroproducts 606 constant speed, reverse thrust, hydraulically actuated propellers are used. In addition to automatic synchronization, a phase synchronizer selects and maintains optimum blade angular relation between propellers to cut noise, vibration.

Automatic feathering is provided should an engine fail on takeoff. Thrust sensitive signal system is armed on takeoff and automatically will feather if the power delivered to the propeller drops to 500 lb. propeller thrust. During the feathering cycle, the propeller would be delivering a small increment of thrust to the aircraft.

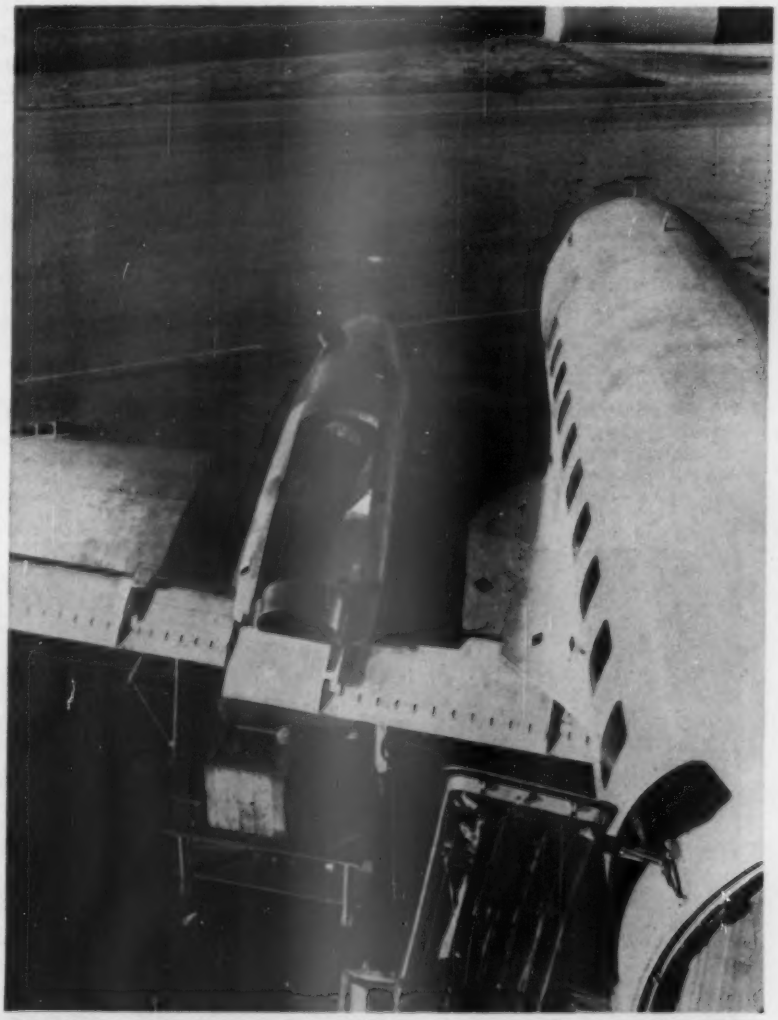
In flight, a negative torque signal unit is set to operate if it senses between 250 and 370 negative horsepower. Effect is that when the propeller starts to drive the compressor the signal acts to "coarsen" the propeller pitch to unload the drag. The signal then causes a cycling of the propeller pitch, producing a slight yawing moment.

If failure becomes more progressive, such as the sudden seizure of the compressor caused by foreign object ingestion or oil starvation, an automatic feature decouples the propeller from the engine when engine drag reaches 1,450-1,850 negative horsepower. Allison engineers figure the power drag of an unfeathered propeller driving a dead engine to be about 40,000 hp.—the amount of energy absorbed in driving the compressor at maximum rated thrust.

Modifications to the airframe includes these features:

• **Over-wing portion of nacelles** is reworked to provide necessary space for the engine and exhaust pipes. The recontoured nacelle is built of stainless steel and the upper portion of the wing beneath the nacelle is re-skinned with same material. Original landing gear fairing doors are used but retracting arms and hinges are beefed-up to permit gear retraction up to 145 kt., rather than 125 kt.

• **Empennage is enlarged** by adding 12 in. to the vertical fin and rudder and 40 in. to the span of the horizontal stabilizer and elevator. Added vertical fin area is required because of the larger asymmetric thrust loads during single engine operation. Increased elevator area is needed to overcome the de-stabi-



STAINLESS steel overwing nacelle is redesigned to accommodate the turbine engine exhaust tailpipe in space formerly occupied by piston-powered Convair's augmentor tubes.

THE NAVY'S POLARIS:

DONNER *helps it think...*

One day soon the U. S. Navy will file a report more fantastic than any sea serpent tale we've ever heard. This will be the launching of the Navy's spectacular Polaris missile from a submerged nuclear submarine. Advanced testing is underway; the Polaris will be ready for the fleet in 1960.

Smaller and lighter than other intermediate range ballistic missiles, this formidable Lockheed developed weapon features much that is new in advanced electronics. It even "thinks" for itself.

One such "think" device aboard the Polaris is a system developed by Donner Scientific Company using as a base a standard Model 4310 Accelerometer. The system monitors flight performance like a policeman directing traffic. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a pre-determined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Donner's role in the Polaris project represents another basic contribution from an engineering team which specializes in accurate systems, interlocking time, acceleration, velocity and other inputs designed to meet customers' requirements.

Donner welcomes your inquiries concerning the company's capabilities in this and related fields. Write Dept. 052.

DONNER SCIENTIFIC COMPANY
Concord, California

16

lizing effect of increasing engine power by 50%. PacAero is using the engineering and design work done by Convair on the empennage when the YC-131 military version was converted to use the Allison T-56 engine, which was the forerunner of the 501-D13 powerplant (AW Oct. 12, p. 37).

• **Engine instrument panel** and new control pedestal also are added. In addition to the thrust levers, conversion includes a fuel shutoff lever and a telltale light panel on the pedestal; panel instruments include tachometers, torque meters calibrated in horsepower, turbine inlet temperature gages, oil pressure and temperature gages, oil quantity gages and recalibrated fuel quantity gages.

• **Fuel system rework.** Original fuel tanks are used but new fuel lines are installed and re-routed. Original fuel booster pumps are retained and fuel quantity gages are re-calibrated for JP-4.

• **Fire extinguishing** system uses chlorobromomethane.

• **Hydraulic system.** Internal piping is retained and one engine-driven hydraulic pump is retained on the left engine. Installation of the compressor in the right nacelle precludes installation of a second engine-driven hydraulic pump and added hydraulic power is afforded by one a.c. and one d.c. hydraulic pump.

• **Electrical system's** engine-driven d.c. generators are retained. Additional electrical power is supplied by two engine-driven 40-kva. alternators. A standby inverter also is retained for flight instrument operation should both alternators fail.

• **Cabin pressurization system** uses a new AiResearch-built engine-driven turbine on the right nacelle and feeds into the plane's standard system manifolding.

• **Hot wing and tail** uses bleed air from the 14th compressor stage. Engine inlets, propeller hubs and spinner are coated with Spraymat for electrical anti-icing. Additional cabin heat, other than that created by the heat of compressing the cabin air, is obtained from an a. c. electric heater.

• **Sound treatment of cabin** includes adhesive foil on the inner skin surface of the 340 aircraft to add mass for soundproofing. Soundproofing also is added in the plane of the propellers. No additional treatment is required on 440 aircraft.

• **Starting system** employs a gas turbine compressor in the right nacelle, making the aircraft independent of ground power for starting.

Optional Items

Optional conversion features consist of two integral tanks in the outboard wing section, adding 350 gal., and 600 gal. of wing tankage inboard of engine nacelles. At the time of conversion, an all-a.c. electrical system can be added at extra cost.

Interior arrangements and seating configuration is at the option of the customer and is subject to negotiation with PacAero, independent of the conversion contract with Allison.

An exchange program is offered by Allison whereby the operator returns a used QEC pack, propeller or related unit to the factory, is given a replacement unit and is charged for the cost of overhauling his returned unit. Allison and Aeroproducts also agree to reimburse airline operators for engine and propeller overhaul and line maintenance costs in excess of a fixed rate per engine fleet flight hour. A similar arrangement, subject to individual contract negotiation, can be made with corporate aircraft operators.

Overhaul Sites

Allison and Aeroproducts also overhaul 501-D13 engines, 606 propellers, Electra QECs and powerplant accessories at factories in Indianapolis, Ind., and Dayton, Ohio, for all U.S. airlines operating Electras. These same facilities will provide complete service for all Super Convair operators who elect the option.

Allison warrants the modified portion of the Super Convair airframe for 1,000 flight hours or six months, whichever expires first. The company also offers flight instruction in the converted airplane and operation and maintenance instruction on the engine and propellers as part of the negotiated contract price.

Convair has pledged to continue supporting the unmodified portion of the 340/440 airframe as long as 16 aircraft of the type, either piston or turboprop, are operating in airline service.

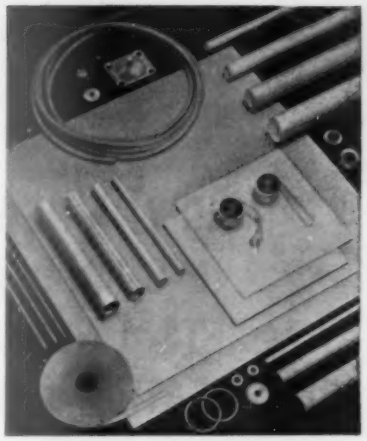
New Il-18 Records

Moscow—Soviet aviation officials say the four-turboprop Il-18 transport recently established five new world records.

The Il-18 carried a 10 metric ton payload over a 5,000-km. closed course at an average speed of 430.3 mph., according to Soviet officials. The 7 hr. 14 min. flight went from Moscow south to Sevastopol in the Crimea, northeast to Sverdlovsk in the Ural mountains and back to Moscow.

New world speed records claimed are the 5,000-km. distance without load and with loads of 1, 2, 5 and 10 metric tons.

Two other records have previously been set by the Il-18. Last August, a "Moskva" turboprop carried 15 metric tons over a 2,000-km. closed course at an average speed of 447 mph. On Nov. 25, an Il-18 lifted a 20 metric ton load to an altitude of 39,370 ft.



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But not now. R/M has perfected a process that makes "Teflon" easily bondable to other materials and to itself with commercial adhesives. Now you don't have to design intricate "Teflon" parts in a single piece or devise elaborate and costly fastening methods.

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A lot is happening in "Teflon" daily. To keep up with it, talk "Teflon" with the R/M man—learn of R/M's *complete "Teflon" service* that can help you improve design and increase reliability even while cutting costs. Call one of the offices listed below or write Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

*Du Pont trademark for its TFE-fluorocarbon resin

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SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

SPECIALISTS IN ASBESTOS, RUBBER, SINTERED METAL, ENGINEERED PLASTICS

NOW! A NEW CONCEPT
IN COMPUTER DESIGN
SETS A NEW STANDARD
OF VERSATILITY AND VALUE!

THE FULLY-TRANSISTORIZED

RPC-4000 ELECTRONIC COMPUTING SYSTEM

The RPC-4000 is a new, fully-transistorized electronic computing system with the largest memory, greatest problem-solving capacity and flexibility in the low- or medium-priced field. It is the latest member of a growing family from the people whose LGP-30 has become the world's leading small-scale computer.

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Available at low cost: high capacity, flexibility and ease of operation make the RPC-4000 the outstanding computer value on the market today.

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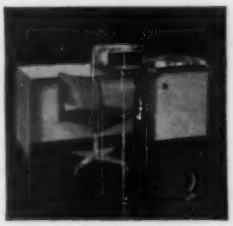
Heart of the RPC-4000 system is a new transistorized computer with advanced design concepts that provide substantial computing speed and capacity in a low-cost unit. Magnetic memory drum stores *8008 words*. Operating speeds are as high as 230,000/minute.

Standard input-output is a tape typewriter system which includes a Royal electric encoding-decoding typewriter complete with desk and chair, plus a tape punch-read console. Read speed is 60 characters/sec., punch speed 30 characters/sec. Typewriter, punch and reader may be interconnected in any combination for both on-line and off-line operations.



A new 500 character/sec. photoelectric tape reader and a 300 character/sec. punch are available as optional input-output equipment. A magnetic tape unit and a line printer will be available soon. As many as 17 input-output devices (60 with minor modification) may be connected on-line to the basic system. All peripheral equipment is under automatic program control of the computer.

Royal Precision Corporation

Royal Precision is jointly owned by the Royal McBee and General Precision Equipment Corporations. RPC-4000 sales and service are available coast-to-coast, in Canada and abroad through Royal McBee Data Processing Offices. For full, detailed specifications on the new, transistorized RPC-4000, write **ROYAL McBEE** data processing division, Port Chester, N.Y.

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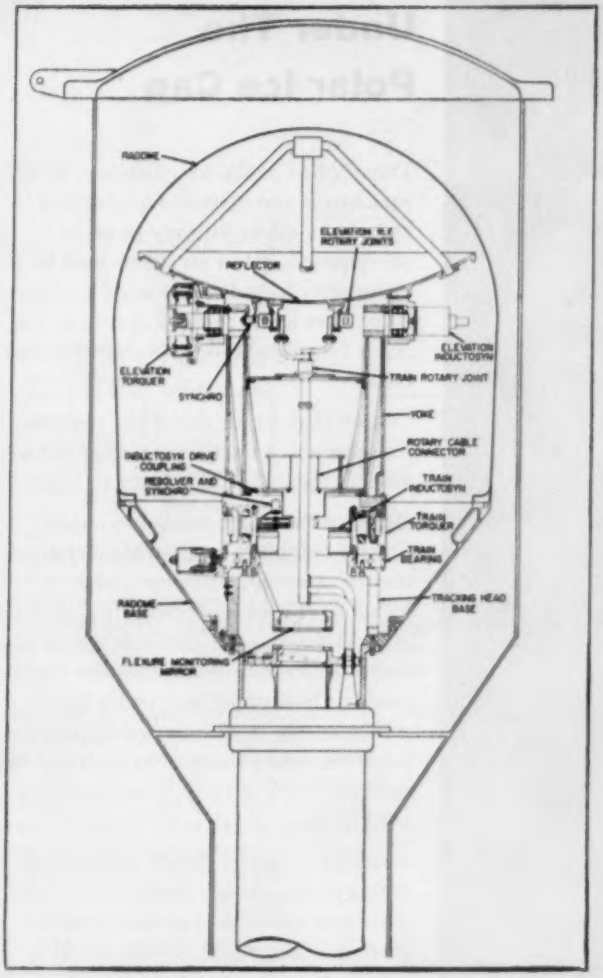


TRACKING HEAD of electronic sextant is almost fully assembled (right) in laboratories of American Standard's Military Products Division. Drawing (left) shows details of the tracking head covered by plastic radome within an enclosure atop a submersible mast.

Radio Sextant Developed for Submarines

By Barry Miller

Norwood, Mass.—An electronic sextant capable of correcting inertial navigation systems of Polaris missile submarines is nearing completion here in the laboratories of American Standard, Military Products Division.

Essentially a radio telescope designed for underseas operation, the sextant will lock-in on X-band radio emission from the moon, the sun or ultimately other stars besides the sun and will provide corrections for errors due to gyro drift in the ship's inertial system. The combination—ship's inertial navigation system and the electronic sextant—will provide Polaris submarines with an accurate, all-weather navigational capability.

In addition to the sextant, American Standard engineers are putting the finishing touches on a second navigational aid, this one known as a Type 11 periscope. Inherently of greater accuracy than the sextant but restricted to clear weather use only, the periscope enables an operator to visually locate a true star position and manually enter information which corrects the inertial system's prediction of the ship's position.

Retractable Mast

Operation of these complementary aids requires, however, that the submarine rise to a sufficiently shallow depth from which either a retractable mast housing the sextant's antenna or the Type 11 periscope can be extended above the ocean's surface.

Besides its all-weather capability, the radio sextant type of navaid, American Standard engineers say, has another feature of military interest—it is extremely difficult to jam. To disrupt this system, large bursts of energy must be generated on a line of sight between the antenna and the celestial body on which the several minutes-long fix is taken, precisely when it is taken.

American Standard has orders to finish only one sextant for the present, but funds have been allocated for radio sextants to go into the remaining Polaris submarines. At least one firm is currently running a radio sextant design study and another—Collins Radio—like American Standard, has previously designed radio sextants for surface vessels.

Under a $5 million Navy contract,

Crosley Amplifiers— Under The Polar Ice Cap

Today's Navy calls for reliability. New submarines and surface ships demand technical mastery in every phase of development. When amplifiers used in underwater torpedo fire-control systems failed after a few hours of operation, the Navy turned to Avco's Crosley Division for help.

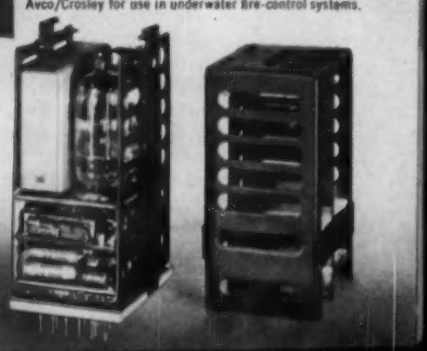
Crosley engineering solved the problem. The product: an amplifier that operates without failure for 2000 hours or longer.

Recently the Navy decided to install Crosley amplifiers in fire-control systems aboard many of its modern vessels—including the nuclear-powered submarines *S.S.(N)Nautilus, S.S.(N)Skate, S.S.(N)Sargo,* and *S.S.(N) Swordfish.* When the *Skate* made its historic journey under the Arctic ice cap in 1958, it had Crosley-made amplifiers aboard. Today, some ten different types of Crosley amplifiers are used by ships of the U.S. Navy.

Crosley's talent for design, engineering, and manufacture of transistorized amplifiers has secured an important place for this critical equipment. It is reflected in airborne television gun-sighting equipment purchased by the U.S. Air Force, in the huge FPS-26 height finder radar for perimeter defense, and in the Navy's *Polaris* missile system.

For more information on amplifiers designed and produced by Crosley, write . . . Vice President, Marketing-Defense Products, Crosley Division, Avco Corporation, Cincinnati 25, Ohio.

One of a series of midget servo amplifiers developed by Avco/Crosley for use in underwater fire-control systems.



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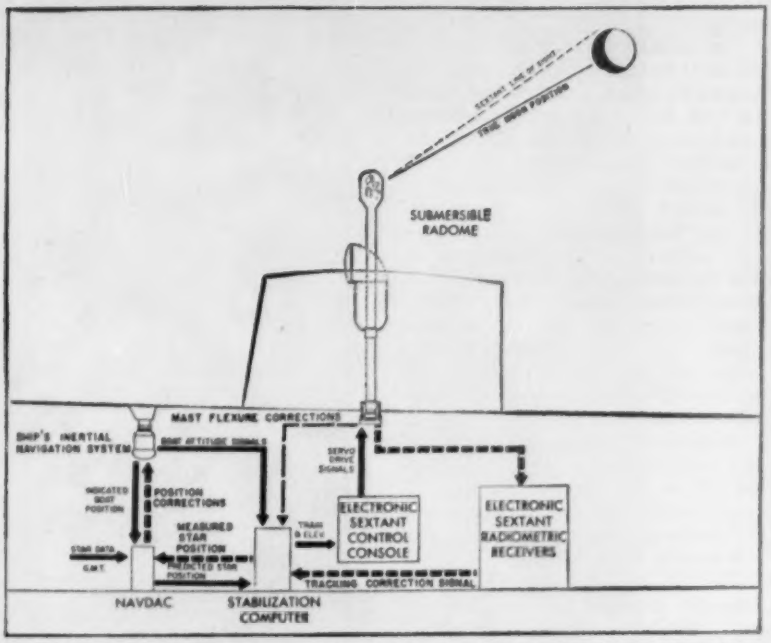


RADIO WAVES from the moon are used in assisting inertial system in determining submarine's exact position to satisfy missile launching needs. Signal flow indicates how sextant is tied into ship's inertial navigation system. Electronic sextant will periodically take fixes on sun or moon even on days with heavy cloud cover.

the local firm has the over-all responsibility for designing and fabricating the sextant parts which have been supplied by several subcontractors. Among these is Ewen-Knight Corp., in nearby Natick, which has designed and developed the radiometric receiver.

The sextant operates as follows: The submarine's position in latitude and longitude, predicted by SINS (Ship's Inertial Navigation System), provides one input for a NAVDAC (Navigation Data Assimilation Center) computer. With this indicated ship's position along with star data, the NAVDAC computer predicts the position of the celestial body to be tracked. Simultaneously, signals corresponding to pitch, roll and heading of the submarine are fed into a stabilization computer.

The predicted celestial target's position then is entered into the stabilization computer which converts three-axis data into elevation and train. These signals are fed in turn into a console where drive signals position the tracking head into the predicted celestial position.

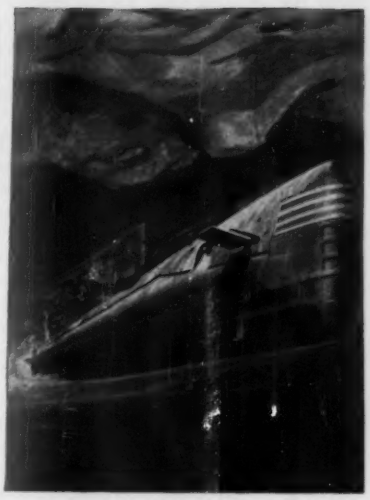
Radio waves from the celestial body cause the sextant line-of-sight to move from the predicted position to a true celestial position. The difference between the predicted and the true positions is detected as bearing and elevation corrections by the antenna and radiometric receiver. A tracking correction signal is fed back from the receiver to the stabilization computer, where its coordinates are converted back to earth coordinates, sent to the NAVDAC computer from which corrections are then directed into SINS. The NAVDAC computer can also accommodate information from the Type 11 periscope for correcting SINS.

The Polaris electronic sextant evolved from the firm's earlier Navy-backed work with Ewen-Knight on a radiometric tracker for surface vessels originally slated to launch Jupiter missiles. For the project, Ewen-Knight developed an 8-kmc. traveling wave tube radio telescope receiver combined with a 28-ft. antenna which was able to receive signals from 12 radio stars.

As its part, American Standard came up with a seagoing four-axis mount, gimbaled in roll, pitch, azimuth and elevation. A gyro-accelerometer package on the azimuth gimbal generated a true vertical to offset structural deflections of the ship's mast.

In January, 1958, the Navy amended the original contract and told contractors to redirect their work for underseas operation. This required immediate reduction in the antenna reflector, thus limiting reception to signals from the moon and the sun. In addition, it was necessary to find ways to:

- **Support the antenna** over the surface.
- **Exclude sea water** from the antenna and the RF tracking component.
- **Measure the attitude** of the antenna line-of-sight with respect to a coordinate reference within the submarine.
- **Assure transmission** of RF energy



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Avco/Crosley

from the antenna into the submarine.

A stainless steel tubular mast almost 35 ft. in length was selected for the antenna support. In its retracted position, it is stored within a sealed tank in the sail structure.

A rigid reinforced plastic radome, ¼ wavelength in thickness, covers the tracking head which consists of the antenna and two-axis drive motors. The radome was selected to have small enough reflection of RF energy to get navigational accuracy and of sufficient strength to withstand wave impact forces. A quartz window at the base of the mount prevents entry of seawater into the vessel.

The two-axis tracking head with motors is mounted atop the mast. A flexure monitor indicates how much the mast bends with water drag and rolling and pitching of the boat and supplies correction signals to the ship's stabilization computer.

In the flexure monitor system, a beam of light is projected from a telescope at the base of the mast and reflected from a mirror on the tracking head base and refocused on a detector in the telescope. This provides the means for measuring the tilt of the top of the mast. The flexure monitor is a two-axis automatic autocollimator and incorporates an optical cube, a box with mirrors on its four vertical sides, that serves as the basic reference to the ship's coordinate system.

Assure Transmission

To assure transmission of RF energy through the mast into the receiver, the best low-noise transmission lines were selected. Efforts are being made to balance and remove reflection points on the lines. As indicated previously, size of the antenna and sensitivity of the radiometric receiver limit celestial reception to the moon and the sun. The moon is preferred because it is more stable radiometrically. This may be changed if receiver sensitivity can be improved. Presently, the receiver employs traveling wave tubes but is intended to be convertible to wideband Masers if the latter become available. A Maser with 100 mc. bandwidth would be necessary to equal the performance of the receiver with traveling wave tubes.

If a more sensitive receiver were designed into the sextant, it is likely that the antenna dish would again be reduced to lessen the bulk on the mast. The present system is said to be a fine balance of antenna size, cost and receiver sensitivity.

Ewen-Knight currently has a separate million dollar contract from the Navy which covers the study of solid-state preamplifiers—Masers and parametric amplifiers—from which better devices for increasing system sensitivity may emerge.

The sextant's radiometric receiver will be at least as sensitive as a standard radiometer which is capable of detecting 0.1K noise temperature differences, a spokesman for Ewen-Knight said.

Besides Ewen-Knight, the firms working with Military Products Division on the sextant and the items they supply include: Brunswick-Balke-Collender Co.—the radome; Edo Corp.—the mast; Allied Research Associates, Inc.,—the radome hydrodynamic tests; Perkin-Elmer Corp.—the flexure monitor; Epsco, Inc.—the stabilization computer; and Advanced Technology Laboratories Division of American-Standard—environmental controls.

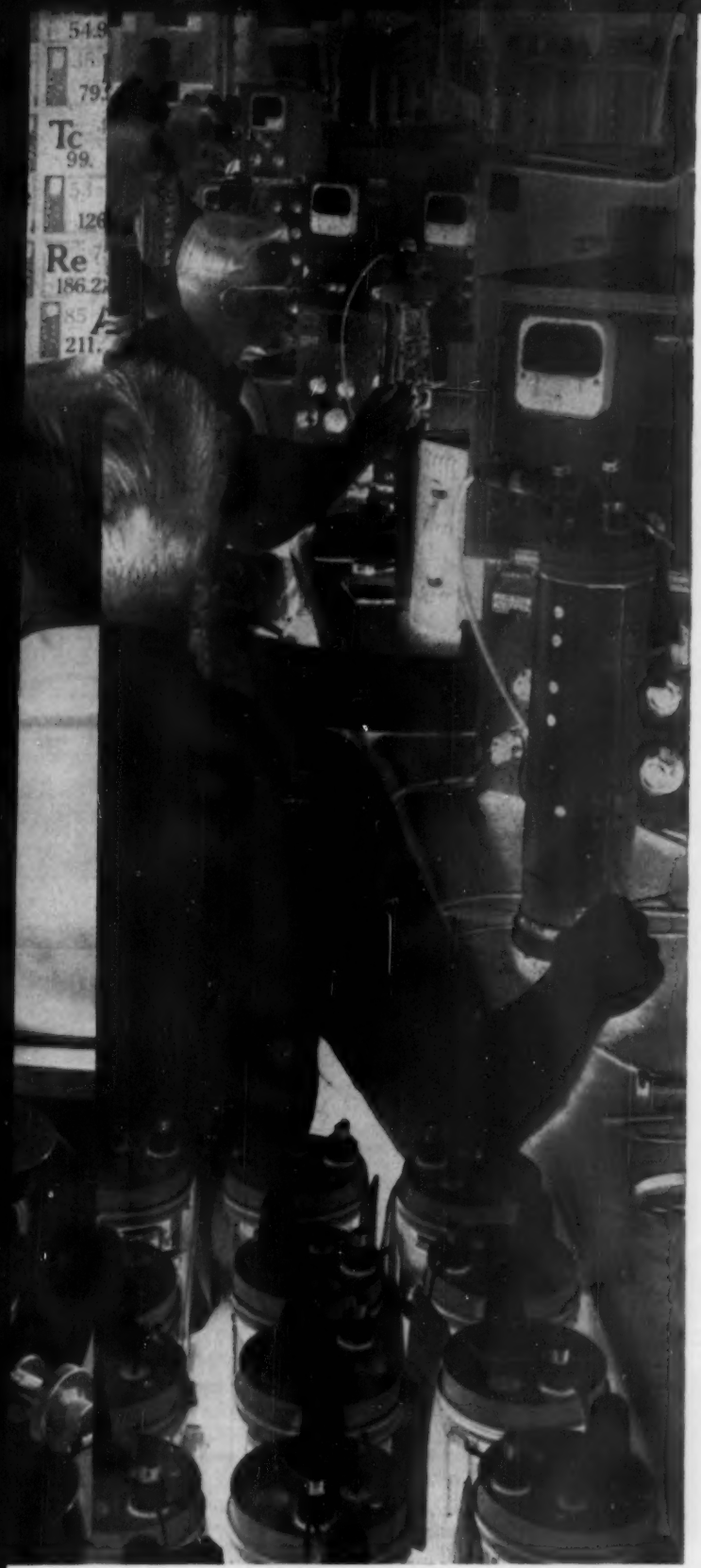
Aside from its responsibility for design and integration of all parts into the sextant, the Military Products Division handled the tracking head servos, the tracking electronics and the control console.

The Military Products Division of American Standard has been active in gyro stabilization, coordinate transformation computers and precision navigation computers for the past 12 years. Originally known as Control Engineering Corp., the firm was acquired in 1955 by American Radiator & Standard Sanitary Corp. as a unit of its Detroit Controls Corp. It has since matured into a separate division of American Standard specializing in components, as gyros, accelerometers and shipborne navigation computers.

FILTER CENTER

▶ **Low-Cost DME-T Reports Available**—Quarterly progress reports on a Federal Aviation Agency-sponsored program to develop a minimum-cost distance measuring equipment, under way at National Aeronautical Corp. (Narco), are available to avionic equipment manufacturers who may be interested in manufacturing such equipment. Requests should be directed to Bureau of Research and Development, Federal Aviation Agency, Washington 25, D. C.

▶ **New Firm To Exploit Video-Sonics**—Applied Communication Systems is the name of a new firm formed to assist industry in application of new Video-Sonics technique, developed by Hughes Aircraft Co., which speeds employe training, slashes defect rate and increases output (AW Jan. 4, p. 75). The new firm, a division of Science Research Associates, Inc. of Chicago, is headed by Donald E. Stewart, who formerly headed the Hughes Video-Sonics project. Applied Communication Systems address is 8535 Warner Drive, Culver City, Calif.



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RESEARCH, DESIGN, DEVELOPMENT AND PRODUCTION OF DEPENDABLE COMMUNICATION, NAVIGATION AND RELATED ELECTRONIC EQUIPMENT SINCE 1928

Idlewild Installs IFR Narrow Gage Lights

By Barry Tully

New York—Improved traffic handling of jet and conventional aircraft under instrument flight rules at New York International Airport will result from the commissioning of Runway 4R as an instrument runway at a cost of $9.2 million.

Runway 4R-22L at Idlewild, equipped with narrow gage and centerline lights and high speed exits, became an instrument runway last week following Federal Aviation Agency installation of approach lights at its southwest end. The 8,400 ft. runway, in landing used during visual flight weather conditions since October, 1959, will be fully instrumented in both directions sometime this spring.

The commissioning of 4R-22L as an instrument runway frees its twin to the west, 4L-22R, for takeoffs. This takeoff runway will be extended 600 ft. to the northeast and 3,550 ft. into Jamaica Bay for a total length of 12,000 ft. If takeoff performance remains constant, the increased runway length will provide greater safety margins in the event of aborts and will permit aircraft to reach higher altitudes while within field boundaries, thus lessening noise problems.

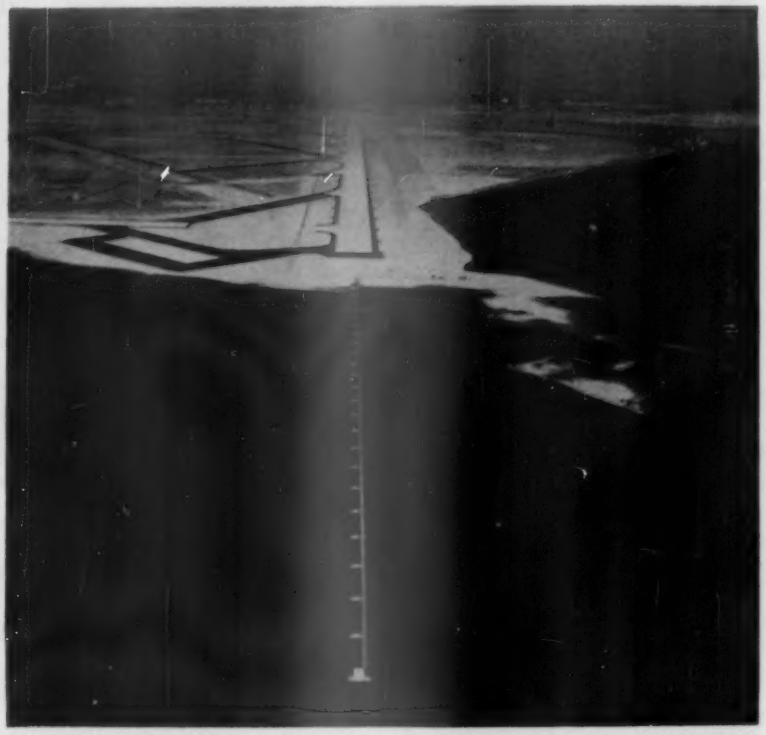
The added length also could be used to increase allowable takeoff weights.

The instrument runway, 4R-22L, is the first commercial airport runway to employ flush-mounted narrow gage and centerline lights. These innovations are combined with flashing strobe approach lights, dual ILS, and lighted high speed turnoffs.

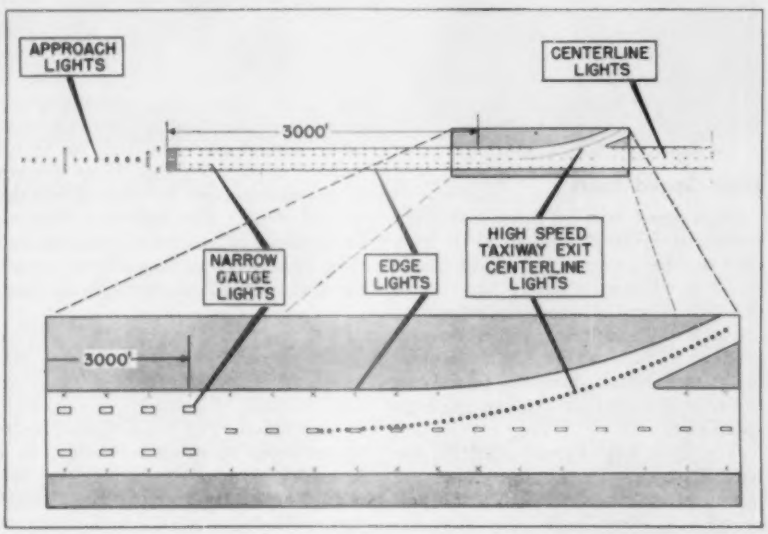
System Tested

The narrow gage lighting system, designed to eliminate touchdown in the so-called "black hole" of conventionally lighted runways, was tested at Dow AFB, Me. (AW Dec. 1, 1958, p. 39). A second Air Force installation of the system is at March AFB, Calif. At both Dow and March the flush light system is used by Boeing B-52 bombers with heavier landing weights than any commercial jet transport now flying.

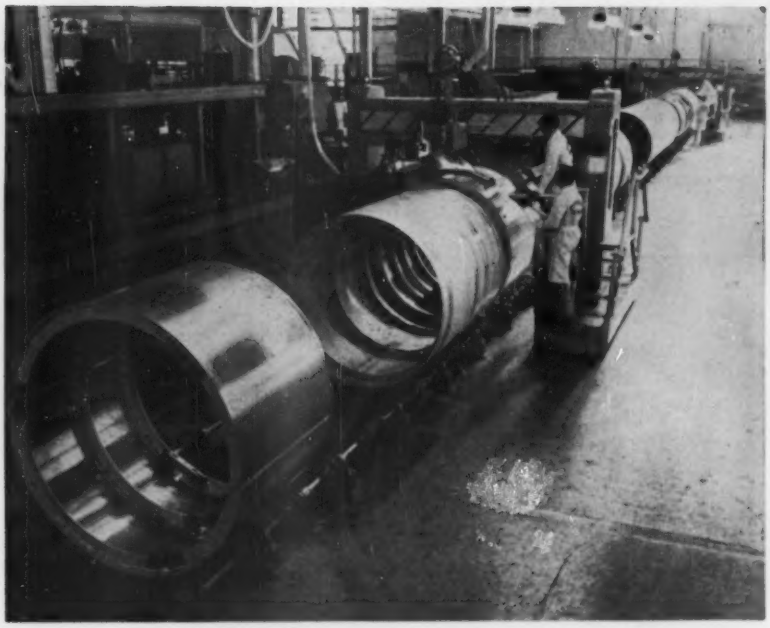
The narrow gage lights—the 60 ft. gage appears narrow to pilots, in comparison with conventional lights at the runway perimeter—are placed in batteries of three, 30 ft. from the centerline, at 100 ft. intervals down the runway. This double row extends for 3,000 ft. from both ends of the runway. The remaining center section is lighted by a



APPROACH end view of Runway 4-right, Idlewild's new instrument runway, shows approach lights in Jamaica Bay and high speed exits to the left of the 8,400 ft. strip. The four high-speed exits, (two per landing direction), permit turnoffs at 3,330 ft. or 5,730 ft. at rollout speeds to 60 kt.



LIGHTING configuration of Runway 4R-22L is shown in sketch. The narrow gage flush lights extend 3,000 ft. from each end of the runway with centerline lights covering the remaining 2,400 ft. distance. Enlarged insert shows the location of the flush pancake lights (black dots) which lead the pilot through the high-speed exits at night.



Gantry Welders Used in Redstone Production

Girth welding of the modified Redstone shells to be used in the Project Mercury preliminary sub-orbital flights is accomplished by means of two gantry welders on 180-ft. tracks. Welders, developed by the Reynolds Metals Co., Sheffield, Ala., permit workers to align the aluminum shells before the gantry is rolled into place.

single row of lights on the centerline.

The lighting system, as seen by a pilot on landing approach, appears as a narrow strip of white lights centered between the runway lights. If the aircraft is not aligned with the center of the runway, just one row of lights will be visible. Correction toward the single row will bring both rows into view, indicating alignment with the centerline.

When the aircraft is over the runway the pilot touches down on or between the narrow gage lights rather than settling, as on runways without narrow gage lights, into a dark area between the edge lights. The flush lights present a textured light surface which is intended to aid depth perception.

High Speed Exits

High speed exits on runway 4R-22L, located at 3,330 ft. and 5,730 ft. from each threshold, permit turnoffs at speeds to 60 kt. The exits have a turn radius of 1,800 ft. and intersect the runway at an angle of 30 deg. At night, white pancake lights, flush mounted in the runway at 20 ft. intervals, lead the pilot from the runway centerline through the high speed exits.

The flush light fixtures used for the narrow gage and centerline lights are produced by Structural Concrete Products Corp., New York. The steel fixtures, called Elfaka, are a Dutch design purchased by Structural Concrete. The Elfaka units are narrow steel boxes ranging from 6 to 10½ in. in width, 8 ft. in length and 12 in. deep, oriented lengthwise along the runway.

Each Elfaka unit houses one or two General Electric PAR 36 (parabolic aluminized reflector) lamps. The fixtures are covered by a heavy steel grille capable of withstanding direct impact landing loads. The forward half of the fixture is made up of a series of long, narrow channels, through which light is transmitted toward the oncoming planes.

The 100-watt PAR lamps are capable of producing 90,000 peak beam candlepower at maximum rated current of 20 amp. This degree of brightness would be required only under minimum visibility conditions. For use in better weather conditions, four lesser degrees of brightness may be selected by the control tower. The Industrial Heating Department of General Electric, Shelbyville, Ind., developed a 1,500-watt heating unit for the flush lights for de-icing.

Tubular Lamps

Flush-mounted turnoff lights, also produced by Structural Concrete, utilize General Electric's "Quartzline" 45-watt lamps. The small tubular lamps are expected to generate enough heat to melt snow and ice, eliminating the need for de-icing heaters. The circular pancake fixture itself is 5⅛ in. in diameter and rises less than ¼ in. above the runway surface. The "Quartzline" lamp is recessed under a protective steel plate and its light shines out through two

SIMULATORS–BASIC TOOLS IN VOUGHT RESEARCH

The Manned Space Flight Simulator Laboratory shown opposite is designed to answer difficult questions posed by manned space flight.

Vought Astronautics has already faced and solved many problems during initial development of the *Dyna-Soar* orbital boost-glide vehicle. Developmental studies and feasibility tests by this division have added up to over two years of pathfinding–particularly in the matters of integrating man and space machine, combatting prolonged high temperatures, and designing reliable crew escape systems.

To determine, for example, what control capability the space pilot must have and what displays he will need, Vought Astronautics constructed a Fixed-Base Simulator which simulates real time from end of boost, throughout orbit, reentry, hypersonic glide and supersonic approach to a point over destination.

Operated under normal and emergency conditions on more than 200 "flights," this simulator has provided a basis for evaluating pilot ability to fly complete space missions reliably and effectively with manual control.

In the structures design and materials development on the *Dyna-Soar* nose section and escape capsule, Vought Astronautics developed new methods for combatting the extreme heat of the nose cone during re-entry while maintaining the crew compartment at a livable temperature. Related tests in Vought's Re-entry Temperature Simulator have subjected a full-scale nose cap to over 3,000 degrees F. for prolonged periods.

Vought Astronautics' simulator concepts are the vanguard of a new family of research tools – comparable in value to today's wind tunnels and computer laboratories . . . and aimed at ensuring a place for man in pioneering this new frontier – space.

Space is the specialty of Vought Astronautics. Other major interests are being aggressively advanced in the Aeronautics, Electronics, Range Systems and Research Divisions.

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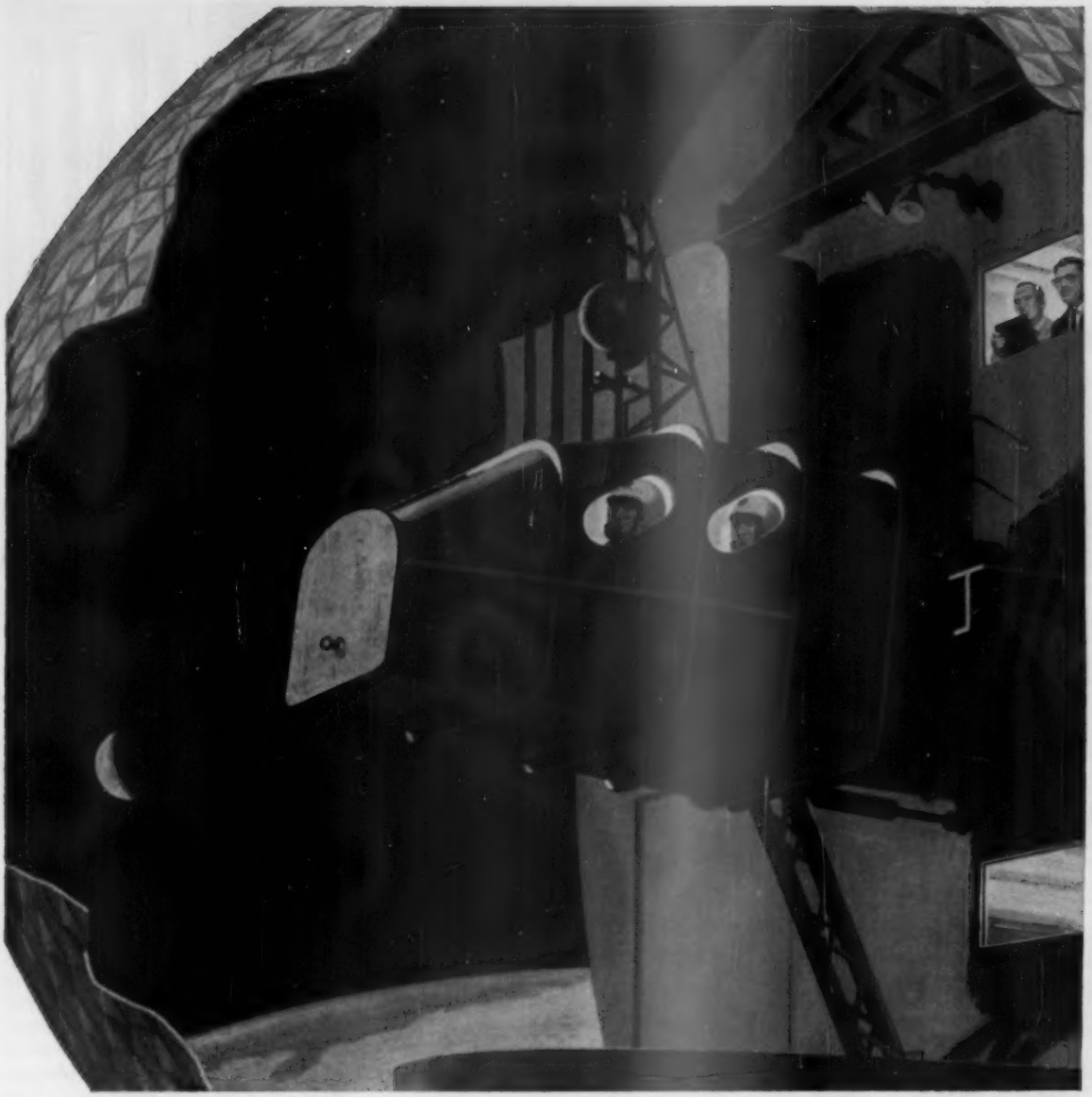
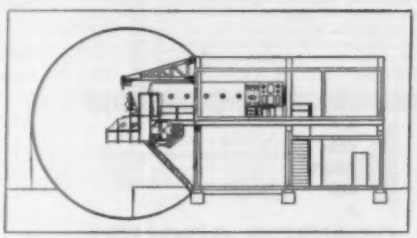


A PLACE TO IRON OUT THE STRESSES OF SPACE

Seventeen different stresses will flay the minds and bodies of the first spacemen. Under the combined attack of acceleration, anxiety, heat and other stresses, how will man perform? The answer won't be known until the problem can be simulated, in all of its parameters. Vought Astronautics – a division of Chance Vought – is preparing the way with design studies of simulators like that illustrated above. Inside the laboratory's mock space vehicle, a man – without leaving the ground – would know the heat, movement, noise – and many psychological effects – of an extra-terrestrial voyage. He would glimpse a dynamic solar system and would experience, altogether, an invaluable preview of combined stresses of space flight. Vought Astronautics can produce and operate such a lab now for the development of spacecraft and the training of pilots.



From active flight instruments, motion, and a planetarium projection — a realistic preview of space flight.

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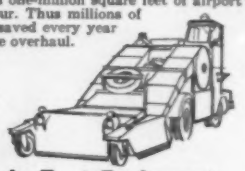
Ground Support Equipment

The pioneer in the field, Consolidated Diesel's Aircraft Equipment Division designs and builds a wider variety of specialized ground support equipment than any other company. One such product is the all-weather, multi-purpose servicing unit illustrated. It tows aircraft and provides a source of A-C and D-C power for ground maintenance and starting . . . one of thousands in service around the world.

More than 100 of these runway vacuum sweepers have been built by the Aircraft Equipment Division. Each cleans one-million square feet of airport surfaces an hour. Thus millions of dollars are saved every year in jet engine overhaul.



Electronic Test Equipment

Automatic multiple circuit analyzers similar to the one shown have been built by Consolidated Avionics for major electronics and missile manufacturers. They search more than 2,000 points in a system and point out wiring errors and doubtful connections. It is one of many highly specialized electronic units produced by Avionics. Other products include data reduction systems and a complete line of transistorized power supplies.

Instrumentation and Controls

Consolidated Controls produces instrumentation and control devices and systems for liquid level, temperature, pressure, speed and flow applications. Typical is this gas-filled thermometer which measures temperatures of jet engine air intakes. It provides one-second response and needs no electrical connection.

A facilities and product brochure has been prepared to tell you in greater detail about THE CONDEC GROUP. Send for it today.

THE CONDEC GROUP*

*Consolidated Diesel Electric Corporation

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And its Subsidiaries:

Consolidated Avionics Corp., Westbury, N. Y.
Consolidated Controls Corp., Bethel, Conn.
Hammond Valve Corp., Hammond, Ind.
The Lima Electric Motor Co., Inc., Lima, Ohio

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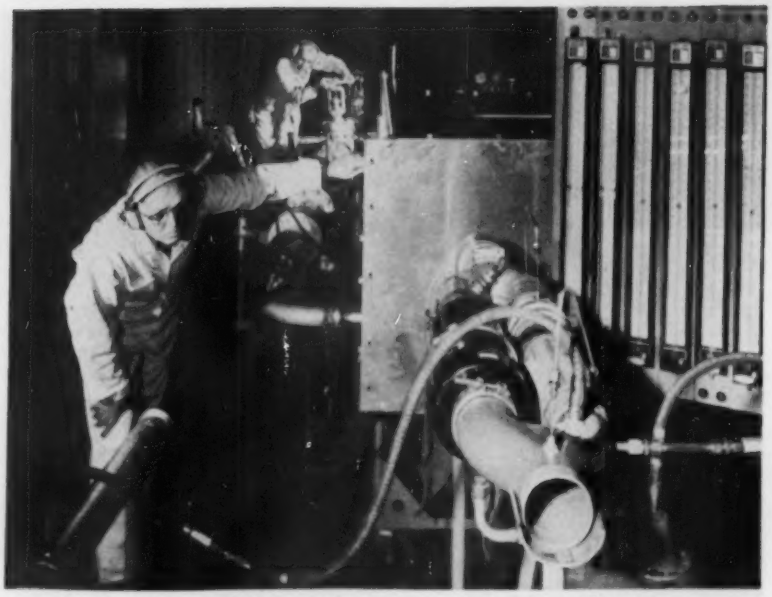

Boeing Tests B-52G Air Conditioning Equipment

Pneumatics laboratory at Boeing's Wichita (Kan.) Division has 800-hp. compressor with air source capability of 2,800 cfm. at 300 psi. Here an air conditioning water separator for USAF's Boeing B-52G missile platform bomber is given performance and qualification tests. Environmental tests are performed under conditions simulating actual operation.

opposite directional channels. Special epoxies are used to cement the pancake light to the runway.

The "Quartzline" lamp uses an "iodine cycle" principle which prevents tungsten from blackening the bulb wall. Thus, the bulb has little tendency to dim throughout its life.

WHAT'S NEW

Publications Received:

Aircraft Electrical Engineering—G. C. Wakefield—The Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. $10.00; 349 pp. Based on a series of lectures given at the Imperial College of Science and Technology, London, with special attention given to the presentation of environmental characteristics.

Airman's Integrated Dispatch Essentials—Melvin N. Peterson, 4880 N. Marine Dr., Suite 101, Chicago 40, Ill. Aimed at providing a more efficient method of ascertaining and verifying the appropriate current regulations relating to air operations. The information material presented in this book was taken from Civil Air Regulations, Regulations of the Administrator, ANC Procedures for the Control of Air Traffic and Special Regulations of the Administrator.

Shortwave Propagation—Stanley Leinwoll—John F. Rider Publisher, Inc., 116 West 14 Street, New York 11, N. Y. $3.90; 160 pp. (paperbound). The basic principles of shortwave radio propagation and how it is used in long distance radio communication. A special Global Time Conversion Chart inserted in the book is a special feature.

Advanced Magnetism and Electromagnetism—Alexander Schure—John F. Rider Publisher, Inc., 116 West 14 Street, New York, N. Y. $2.25; 96 pp. (paperbound). Devoted to the explanation of the advanced concepts of magnetism and electromagnetism with the details of the force acting on a charge moving through a magnetic field, induction lines, magnetic flux, Biot's Law, Faraday's Law, Lenz's Law and the Curie-Weiss Law.

Guide to the Space Age—Carl and Hazel Besserer—Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y. $7.95; 320 pp. A summary of terms and their definitions currently in use in space technology and associated fields of rocketry and guided missiles. It contains a cross-referenced listing of more than 5,000 definitions.

Resistance and Resistors—Charles L. Wellard—McGraw-Hill Book Co., Inc., 330 W. 42 Street, N. Y. 36, N. Y. $8.50; 272 pp. Basic aspects of resistance and of the materials used in the manufacturing of resistors. Charts and graphs provide useful information regarding power and voltage ratings of

resistors, the varieties of material used in their construction and applications. Comparison can be made of the full technical scope of available resistors from tables provided.

New Dimensions of Flight—Lewis Zarem—E. P. Dutton & Co., Inc., 300 Fourth Ave., New York 10, N. Y. $4.50; 256 pp. Aimed at giving young people a basic understanding of the forces of flight; principles and concepts, from faster-than-sound airplanes to the conquest of space.

Grand Old Lady—Lt. Col. Carroll V. Glines, Jr., USAF, and Lt. Col. Wendell F. Mosley, USAF, Pennington Press, Wrigley Bldg., Chicago 11, Ill. $3.95; 250 pp. An account of the Douglas DC-3 from its beginning in 1932 through the Spanish Civil War, the Berlin Airlift and its various missions in World War II.

Aerial Photographic Interpretation—Donald R. Lueder—McGraw-Hill Book Co., Inc., 330 W. 42 Street, N. Y. 36, N. Y. $17.50; 452 pp. (6¾x9¾). The science and art of photographic interpretation as an aid to integrated terrain studies of every type. Classification systems, photo-interpretive keys and others are discussed. The principles and applications of this subject are shown in a wide variety of engineering and scientific fields.

Dictionary of Atomic Terminology—English, German, French, Italian—edited by Lore Lettenmeyer—Philosophical Library, Inc., 15 E. 40th Street, New York 16, N. Y. A section devoted to each language with equivalent numbers provides selection of the essential scientific and technical terms used in connection with atomic and nuclear physics, radiation physics and associated fields.

Radar Meteorology—Louis J. Battan—The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Ill. $6.00; 161 pp. The meteorological quantities measured by radar and the relationship of such measurements to more conventional meteorological parameters is covered.

Aircraft & Missiles—D. M. Desoutter—John De Graff, Inc., New York—$7.50; 213 pp. (9x11¼). Coverage of the principles of aviation with different chapters devoted to aircraft propulsion, speed of sound and beyond, special equipment, the history of human flight, physical and medical aspects of aviation, guided missiles and many others. A glossary of aeronautical terms and abbreviations; aircraft designations; and a listing of some aviation organizations are given.

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Photo-Oscillograph showing voltage to 100 kw load as commercial power fails.
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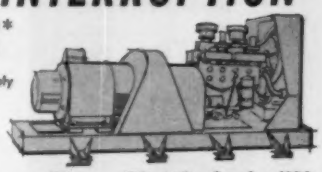
POWER WITHOUT INTERRUPTION with CONDEC'S UPS*

*Uninterrupted Power Supply



Unlike conventional standby generator units, Condec's Uninterrupted Power Supply means power without interruption whenever prime source fails. Controls, relays, lights, radar scopes, computers don't even flicker or pause.

This instantaneous transfer, from prime to UPS generation, with full voltage restoration in 1.5 milliseconds provides the every-second power protection essential to key industrial operations like processing, telemetering, pipelines, automated production lines, as well as such military uses as communications, radar, aircraft and missile ground support.

What the Condec UPS does for you

- Automatic emergency power 5 to 200 kw without interruption.
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- Frequency maintained within 3.5 per cent during transition. Frequency regulation within 1 per cent during operation.
- No transient frequency during load changes.
- Precise voltage regulation guaranteed by static excitation and magnetic amplifier voltage regulator.
- Unattended operation. Automatic synchronization and automatic return to standby.

Patent Pending

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R. E. McDonald, General Manager, Remington Rand Univac Military Division, who has guided the development of all the company's significant military systems.

Noel T. Stone, Chief Engineer, Military Division: "Specialized operation enables us to concentrate on the unique demands of military development. Our reliability effort, for example, has no counterpart."

John H. Vye, Director of Manufacturing: "Complete facilities for design, development, testing, production and field service allow us to keep all elements of a program under one roof."

Lawrence Reid, Manager of Military Field Maintenance and Training: "Univac field maintenance is fully integrated with all phases of the military division, drawing at any time on the full resources and experience of the entire group."

REMINGTON RAND UNIVAC

Military Division

A task force committed to defense programs

An intensified program to bring Remington Rand Univac's capabilities fully to bear on defense programs has resulted in the deployment of our St. Paul laboratories as the company's MILITARY DIVISION. The division embodies complete capabilities for research, design, development, testing, production and field engineering.

The division is a seasoned, functioning unit, with a depth of experience gained in the development of a distinguished series of defense systems. Equipment developed here has pushed the limits of reliability to the farthest point thus far attained. The division is fully capable of undertaking the most exacting programs involving automatic data processing, control systems and specialized electronic equipment.

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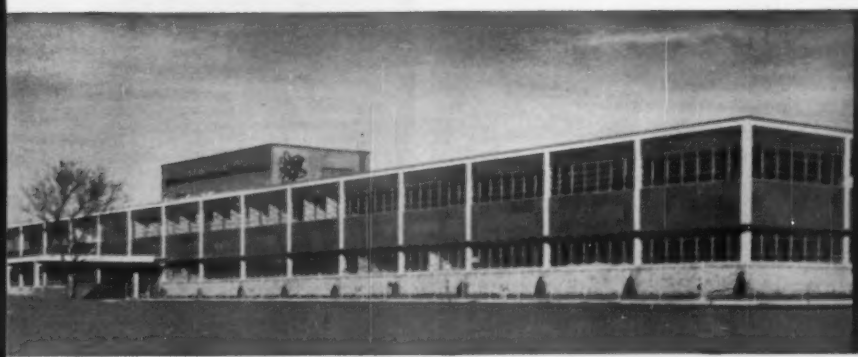

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James Redding, Director of Military Applications: "Experience . . . We can only point to the work we've already done."

Control and data systems developed by the Remington Rand Univac Military Division include:

ATHENA, the Ground Guidance Computer for the U.S. Air Force ICBM TITAN.

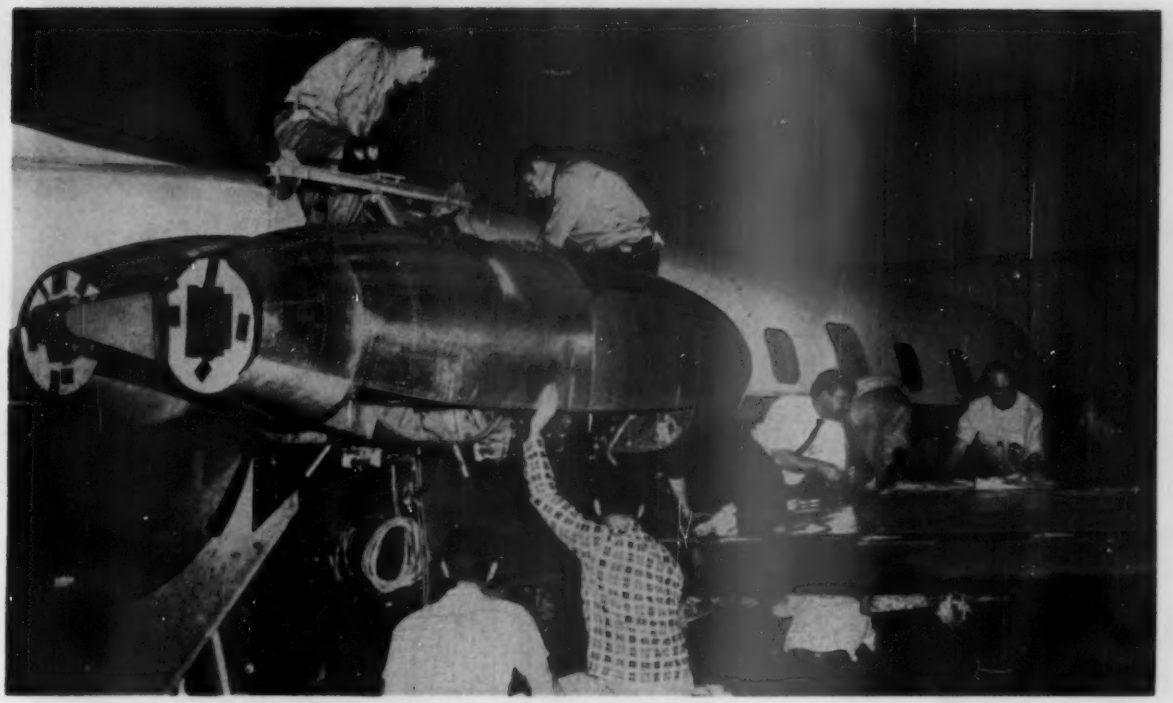
TACS AN/TSQ-13 (Tactical Air Control System for the U. S. Air Force)

BOMARC Computer for the U. S. Air Force Target Intercept Program

SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY

AN/TSQ-20 (Advanced Computer for the U. S. Navy)

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.



Lockheed JetStar Refitted With Four Engines

Lockheed JetStar prototype is fitted with four Pratt & Whitney JT12 turbojets, after two years of flying with two turbine engines. Other workers are installing dual landing gear and high-lift wing leading edges. The repowered prototype will fly in March; first production model JetStar will fly in July.

PRODUCTION BRIEFING

Lycoming Division of Avco Corp., Stratford, Conn., will build a 960-shp. T53-L-5 turbine engine for the Bell HU-1B Iroquois helicopter. The contract from the Air Materiel Command, Wright-Patterson AFB, amounts to $2,485,000 and is expected to reach $7 million. The engine is identical in size with the 860-shp. version used in the HU-1A and has an improved specific fuel consumption of .696.

Goodyear Tire & Rubber Co.'s Aviation Products Division is developing a synthetic rubber liner for the Minuteman missile's third stage rocket engine. The liner, varying in thickness from 0.1 to 1.2 in., burns out simultaneously with the solid propellant, reducing the weight and gage of the casing and leaving the mass ratio at its greatest when the rocket reaches peak altitude. The cylindrical liner is 5.5 ft. long and slightly over 3 ft. in diameter.

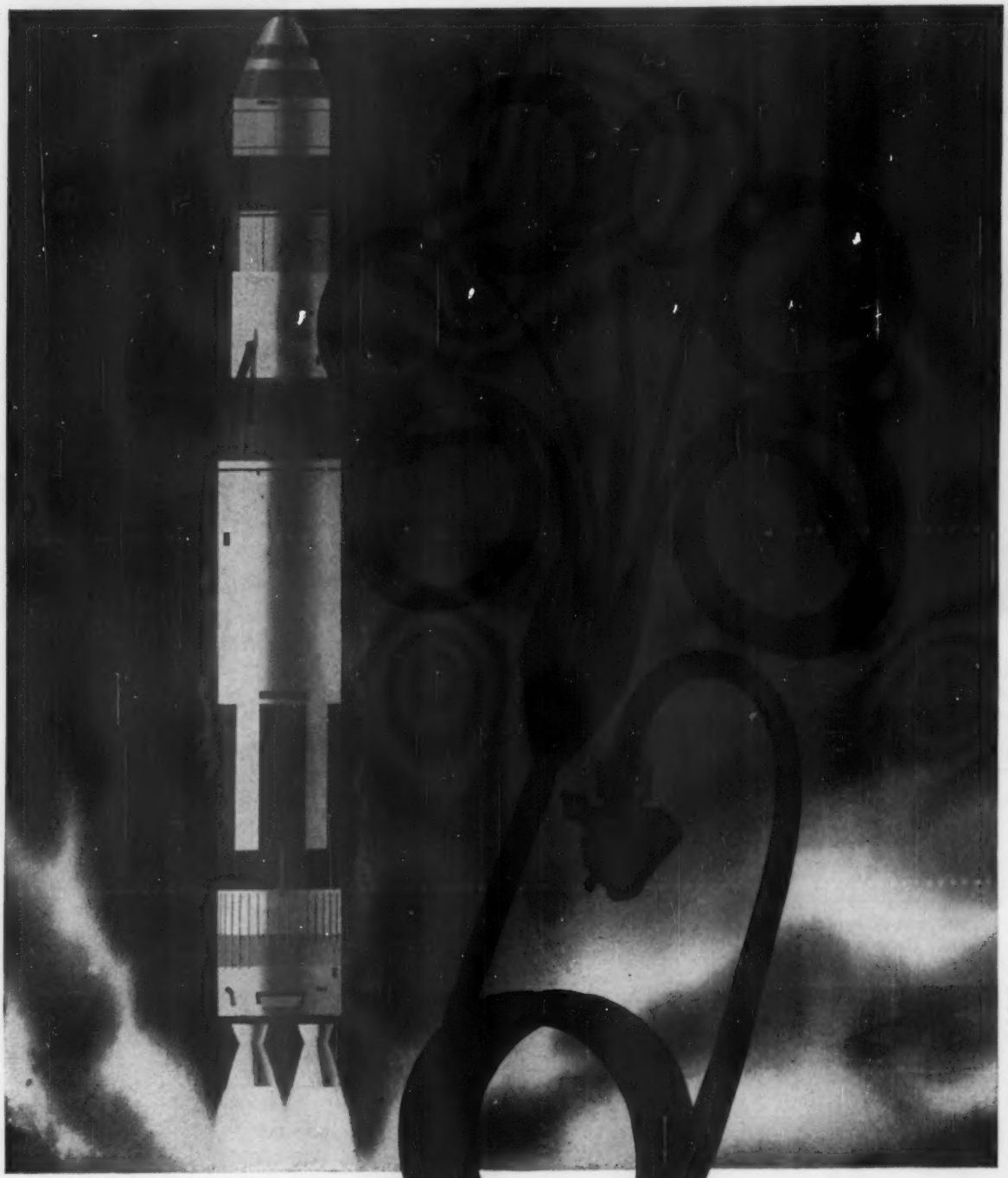
International Business Machines Corp. is now turning out NPN alloy junction transistors at the rate of 1,800 an hour on an automatic assembly line at its Poughkeepsie plant, according to the firm. Assembly system has been operating successfully on a test basis for one month. Another automatic assembly system for making mesa transistors for the Nike Zeus program is being developed at Western Electric (AW Nov. 30, p. 74).

Harvard Graduate School of Business Administration will determine administrative and economic characteristics of the development and early procurement of advanced weapons under a $265,000 grant from the Ford Foundation. Grant also covers investigation of the relationships between the government as buyer and its weapons contractors.

Aerojet-General Nucleonics, a subsidiary of Aerojet-General Corp., is designing a pulsed nuclear reactor for Army's Aberdeen Proving Ground for studying effects of radiation on materials. Preliminary design phase will be finished in six months.

Ryan Vertiplane in Flight

Army-Ryan VZ-3RY Vertiplane, which was destroyed in a crash after pitching up through 180 deg. (AW Feb. 8, p. 36), is shown with large, retractable wing flaps in extended position. Wash from two turbines is deflected by the flaps for VTOL operations.



Umbilical

The MSC-built Umbilical Launching Cable... an example of the product diversity of Missile Systems Corporation. Like all products that bear the MSC label, this system has proven its reliability. Just as it is a life-line to the success of a mission, so also are MSC's contributions material to the future accomplishments of *all* facets of the electronic industry. MSC's variety of products form one continual life-line... feeding an industry which is already changing the life patterns of generations to come.

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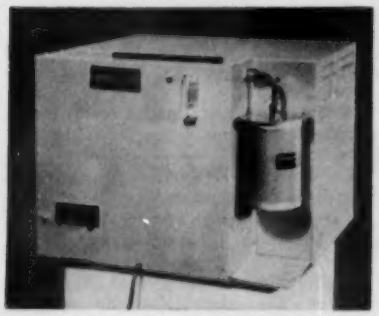
Dallas, Texas

NEW AVIATION PRODUCTS



Transportable Oxygen Generator

Generating unit extracts oxygen from the atmosphere and supplies continuous amounts of the gas at low pressures for welding and medical applications.

The generator, called AerOxy-Gen, supplies oxygen at 5 psi. in less than one minute after activation. The prototype unit is powered by ordinary house electrical current, but gasoline or battery-powered units are planned for field operation. The present model is about 2 ft. square and weighs 150 lb.

Chemical Division, Aerojet-General Corp., Azusa, Calif.

Pressure Transducer

Subminiature absolute pressure transducer is designed to meet requirements of missile, aircraft instrumentation.

Model 420 transducer, utilizing a Ni-Span-C aneroid capsule, produces an electrical output proportional to the absolute pressure. Capsule displacement is transmitted to a wirewound potentiometer producing an a.c. or d.c. signal that can be used without amplification.

A stabilized counterbalance mechanism minimizes the effects of vibration and acceleration. The transducer is compatible with conductive gases or liquids and explosive atmospheres. Liquid oxygen compatibility may be provided in all pressure ranges.

Specifications for typical pressure ranges of 0-10 to 0-350 psia. are: static error band, plus or minus 1.3%; power rating of 1 w. at 165F; operating temperature of −65 to 200F. Transducer measures 1 in. diameter by 1.6 in. and weighs 4 oz.

Bourns, Inc., P.O. Box 2112, Riverside, Calif.

Stretch Forming Snake

Filler snake for use in stretch-forming aircraft and missile parts is constructed of 0.005 in. thick aluminum foil. The material, ranging in price from 30 to 80 cents per cu. in. (depending on cross section complexity), is said to be more economical than conventional fillers. The snake, called HOBE (honeycomb before expansion), is easily coiled for storage and may be machined to make a multi-purpose filler snake.

Hexcel Products, Inc., 2332 Fourth St., Berkeley, Calif.

Ground Power Truck

Mobile ground power unit supplies electrical power to a Convair 880.

The generator of the Hobart Model 3014 unit is rated at 60 kva. or 48 kw. at 0.8 pf., 120/208 v., 166 amp., three phase, four wire, 400 cps. a.c. A V-8 of 157 hp., 549 cu. in. displacement, is coupled to the generator and both are mounted on a steel base, enclosed in steel canopy and mounted on a truck. Controls for the generator and engine are located on a single panel near the power cable.

Motor Generator Corp., Troy, Ohio.

Molded Glass Fiber Insulation

Custom molded glass fiber insulation for missile avionic chassis permits maximum use of cooling air with little increase in weight.

In the insulator illustrated, two sections perform the insulating job done by many small pieces pasted to the metal. The cushioning characteristics of the glass fiber also increases the shock resistance of the chassis.

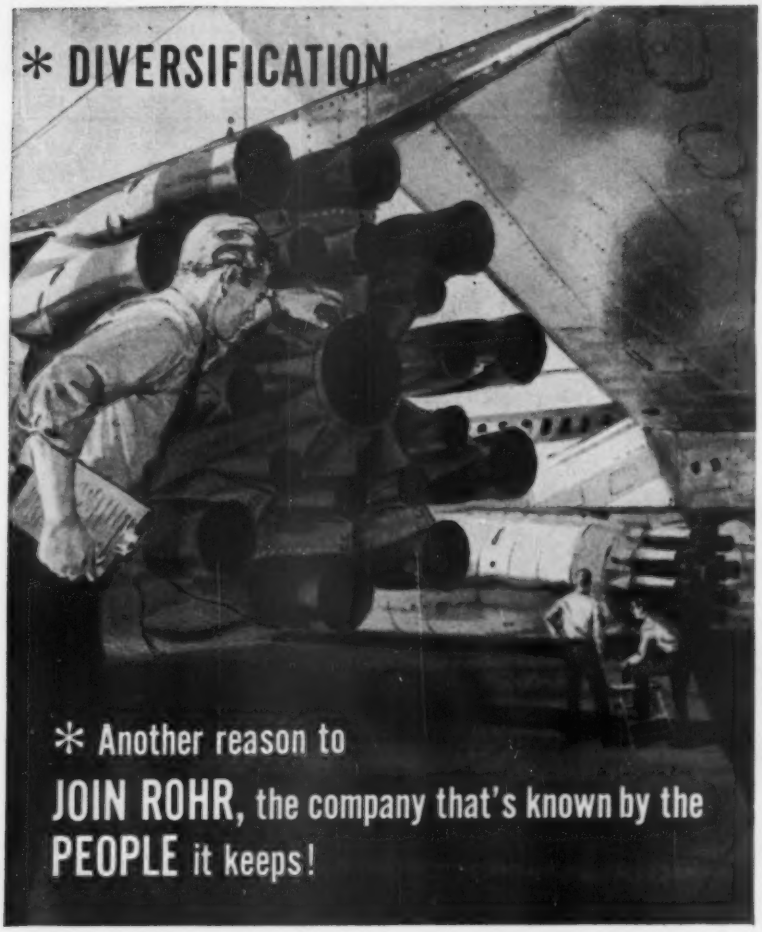
Fibrous Glass Products, Inc., Alpa Plaza, Hicksville, N. Y.

High Speed Camera

Ultra high speed motion picture camera, combining optical, electronic and mechanical principles, can take from 480 to 1,600,000 pictures per second on standard 35 mm. film, in black and white or color. Applications for the unit include fuel detonation studies, solid rocket combustion, plasma studies and ultrasonic flow patterns.

The camera employs an electro-optical shutter which controls the passage of light by means of rapid electric pulses. When a high energy electric pulse is applied, the light is polarized in such a manner that it passes through two polarized filters. A mirror rotating at 100,000 rpm. in the center of a circular film box directs the image onto the stationary film. Light source provided for the .05 to 1.0 microseconds exposure times produces 400,000,000 lumens with 3 milleseconds duration. Camera weighs 700 lb., camera control unit, 350 lb., light control unit, 800 lb.

Benson-Lehner Corp., 1860 Franklin St., Santa Monica, Calif.



Diversification means many things to the people who are contributing their talents to Rohr's unchallenged role as the world's largest producer of components for flight. It means a variety of interesting assignments and the opportunity for personal growth and professional expression. Diversification has led to Rohr's record backlog of nearly a quarter billion dollars — 64 percent in *commercial* contracts — assuring unparalleled stability.

Rohr's diversification is symbolized by the jet power package pictured above, containing 5000 Rohr-built parts, and the Rohr-developed honeycomb brazing process shown below . . .

Rohr invites inquiries from men who can contribute to the company's continued leadership in the aerospace industry. Write to Mr. J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corp., P.O. Box 878-D, Chula Vista, California.

WORLD'S LARGEST PRODUCER OF COMPONENTS FOR FLIGHT

ROHR AIRCRAFT CORPORATION

Chula Vista & Riverside, Calif.

WHO'S WHERE

(Continued from page 23)

Changes

David William Moore, manager, Solid State Physics Laboratory, Lear, Inc., Santa Monica, Calif.

Charles T. Cosser, director of marketing, Lockheed Electronics-Newport Division, Los Angeles, Calif.

Dr. Raymond H. Warner, Jr., chief engineer-diode development, Semiconductor Division of Motorola, Inc., Phoenix, Ariz. Also: **Dr. Robert J. Gnaedinger, Jr.,** division senior solid state chemist.

Austin Stevens, manager of information services, The Martin Co.'s Washington, D. C., office. Also: **Joseph M. Dukert,** manager of information services for the Nuclear Division.

Charles H. Bredall, senior project engineer-advanced techniques, Technical Products Division of Packard Bell Electronics Corp., Los Angeles, Calif. Also: **John M. Evans,** manager of special products manufacturing in the division.

L. H. Orpin, manager for planning, Defense Electronic Products, Radio Corporation of America, Camden, N. J.

Albert H. Bryan, Jr., manager of advanced development, Raytheon Co.'s Missile Systems, Division, Waltham, Mass.

Dr. Robert T. Clark, deputy director, Federal Aviation Agency's Aeromedical Research Institute, Oklahoma City, Okla.

John J. Giba, acting manager, Tele-Dynamics Division of American Bosch Arma Corp., Philadelphia, Pa.

A. C. Butterworth, director of market research and sales engineering-commercial programs, Douglas Aircraft Co., Inc., Santa Monica, Calif.; **L. B. Aschenbeck** will manage market research, and **J. C. Pimentel** will head sales engineering and operations analysis.

Dr. John L. Grigsby, chief engineer, Applied Technology, Inc., Palo Alto, Calif.

Dr. Donald A. Dunn, director of the newly formed Research Division of Eitel-McCullough, Inc., San Carlos, Calif.

Algie A. Hendrix, manager of the AC Spark Plug Division of General Motors Corp., Milwaukee, Wis.

Norman Warren, director of public relations, Northrop Corp., Beverly Hills, Calif., succeeding A. V. Cline, resigned. Mr. Cline will continue as a consultant.

J. Paul Walsh, director, Space and Weapons Systems Division of C-E-I-R, Inc., Arlington, Va. Also: **Fritz W. Wanzenberg,** director of the Management Engineering Division.

Thomas C. Clark, general manager, Houston Fearless Division, Los Angeles, Calif., of Houston Fearless Corp. Also: **James Hannum,** manager-communications research, and **Howard Speer,** senior staff engineer-communications research.

William J. Kuehl, manager-engineering, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

John P. Jasionis, technical operations manager, Research Laboratory, Electron Tube Division, Litton Industries, San Carlos.

Dr. Jay Tol Thomas, director of engineering, Boston Division of Minneapolis-Honeywell Regulator Co., Boston, Mass.

EXPANSION

to keep pace with the growing CHALLENGE of ELECTRONICS at Grumman Aircraft

Grumman Aircraft Engineering Corporation's long and continuing responsibilities for the design of Avionics Systems for ASW, AEW, Reconnaissance, and all-weather attack aircraft has necessitated vast facilities expansion. A new, five million dollar Avionics Systems Center will provide 62,000 square feet of floor space devoted exclusively to activities involving test, evaluation and integration of Avionics Systems.

Concurrent expansion of our staff of electronics engineers and scientists has created positions for men anxious to participate in varied and intellectually stimulating programs utilizing the most modern of facilities.

★ Radar Systems Engineer

EE or Physics degree with a minimum of 5 years' experience in the design, development or analysis of advanced radar systems. Work will consist of Analysis; Preparation of Specifications; Vendor Liaison; Test and Evaluation; Flight Development of the latest airborne radar equipment and systems. Responsibilities include the development of support equipment for these systems.

★ Digital Computer Systems Engineers

BSEE with a minimum of 5 years' experience in the design, development and analysis of digital computers. Should be thoroughly familiar with logical design, circuit techniques, encoders, decoders, magnetic storage devices and programming. Must be capable of integrating the computer system with the entire Avionics System.

★ Automatic Flight Control Systems Engineers

EE or Physics degree with a minimum of 5 years' experience in the design and development of autopilot and flight simulators. Work will involve the development of airborne flight control systems and the establishment of military automatic test equipment requirements.

★ Communications Equipment Engineer

Electronics Engineer with a minimum of 5 years' experience, with thorough knowledge of single sideband theory and its application. Should possess a complete understanding of AM, FM, PM and single sideband modulation processes and their application as well as techniques. Must have experience in analyzing and testing communication receivers and transmitters, and should be thoroughly familiar with HF and UHF antennas and associated propagation problems. A background in digital equipment; encoder, decoder and magnetic storage devices is an important consideration.

★ Laboratory Equipment Engineers

BSEE with 7-10 years' experience in laboratory test programs of airborne Avionics equipment. A working knowledge is required in a majority of the fields of airborne communication, detection, electrical systems, automatic flight control and navigation. An understanding of commercial power systems, electrical distribution, building design and electronic test instrumentation of all types is also necessary.

★ Avionics Support Equipment Engineers

Electronic Specialists in system analysis of airborne digital computers, advanced radar systems, and navigation and communication systems. These Specialists will establish test point requirements and test logic for military automatic line test devices and automatic and manual military shop test equipment. Physics or EE degree required, plus a minimum of 3 years' experience in Avionics support or airborne equipment design and development.

★ Radio Interference Control Engineers

Engineers to analyze the source of conducted and radiated noise interference caused by the interaction of complex electronic equipments and systems; and develop methods and techniques to suppress the interference in the advanced design state of aircraft and missiles.

★ Radome or Antenna Design Engineer

BSEE or Physics degree with a minimum of 3 years' experience in radome design. Background in classical Electromagnetic theory and advanced math essential. Work consists of analysis and synthesis of radomes or antennas on current and advanced designs, including the use of the IBM computer facilities to develop design techniques.

★ Technical Liaison Engineers

Minimum 8 years' combined technical education and experience. Work with and instruct technicians in the test and adjustment of advanced electronic equipment both in a laboratory and after installation in aircraft. Area of work experience should include one or more of the following: Aircraft Instruments, Aircraft Power Systems, Automatic Flight Control Systems, ASW Equipment, Analog and Digital Computers, Data Communication, Data Display, Data Processing, Electronic Countermeasures, Inertial Guidance, Magnetic Detection, Navigation, Radar.

You are invited to investigate these opportunities by sending your resume to Mr. A. Wilder, Manager, Engineering Employment, Dept. GR-25, who will arrange an interview at your convenience. (U. S. Citizenship required.)

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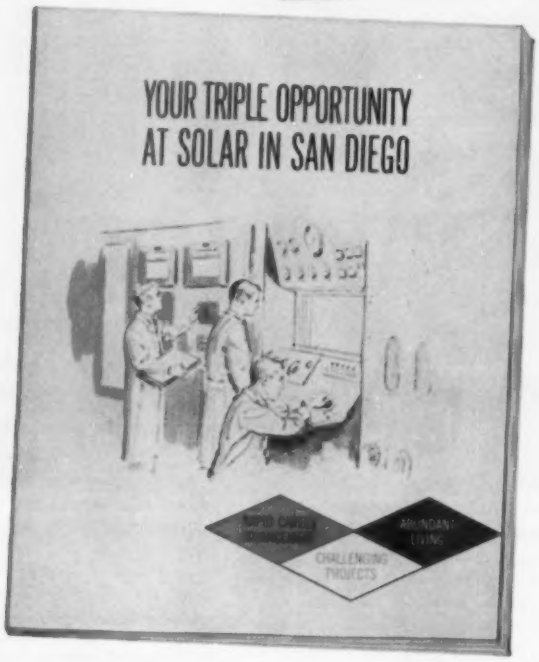

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Opportunity #1: The chance to get in on the ground floor and gain a key creative position with tremendous potential. Solar is humming with exciting and challenging programs. Solar's Missile and Space Group has several highly advanced projects under way. Openings also exist in Solar's fast-moving gas turbine programs.

Opportunity #2: You don't get lost in the crowd! Solar is a medium-sized company (2500 people in San Diego) with a successful history since 1927. Personnel policies are advanced. Salary and performance reviewed semi-annually. Liberal relocation allowances. Professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1960 on the edge of San Diego Bay.

Opportunity #3: The chance to live better in sunny San Diego. This famous resort area has the finest year-around climate in the U. S. Recreational, cultural and educational facilities are excellent. You and your family will enjoy life more at Solar in San Diego.

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In our expanding work of research, development, design and manufacturing of electronic and electro-mechanical systems and components for all branches of the armed forces, we are looking for experienced sales engineers. Salary commensurate with previous experience in government contracts. Travel required. To speed action on resume or inquiry please date same and add: "Aviation Week—Special Attention." Replies in strict confidence to A. L. Buckwalter, Ford Instrument Co., Division of Sperry Rand Corp.

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PROBLEMATICAL RECREATIONS 3

Find the smallest number (x) of persons a boat may carry so that (n) married couples may cross a river in such a way that no woman ever remains in the company of any man unless her husband is present. Also find the least number of passages (y) needed from one bank to the other. Assume that the boat can be rowed by one person only.

—E. Lucas, 1883

The exceptional is the usual in our digital display circuits as well as in central computer circuits using core storage, capacitor storage, and semiconductors. Have you exceptional design ability? Write to Mr. R. W. Robinson.

ANSWER TO LAST WEEK'S PROBLEM: $8x-5(26-x)=0$; $13x=130$; $x=10$

LITTON INDUSTRIES
Electronic Equipments Div.
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LETTERS

Ryan Vertifan

Disappointed you overlooked Ryan and its pioneering and present achievements in VTOL field in excellent story on USAF plans for Mach 2 VTOL aircraft in Feb. 1 issue (p. 38). With X-13 Vertijet for Air Force, Ryan made world's first jet VTOL flights and first transitions from horizontal to vertical flight and return. Ryan pilot Peter Girard, with over 125 jet VTOL flights, has more experience in this field than all others here and abroad combined, and Ryan with three million man hours of jet VTOL engineering has greatest fund of experience of any company. Ryan has also continued to present with successful Army VZ-3-RY VTOL deflected slipstream research plane and under Air Force contract with Ryan Vertifan, or submerged fan, VTOL propulsion system, both widely publicized. Am calling this out because these achievements are not only pioneering but provide armed services with a major platform of experience from which to launch new jet VTOL combat aircraft programs, and because AVIATION WEEK is such an authoritative publication that this article may be considered a complete resume of present funds of knowledge in this specialized field.

WILLIAM P. BROTHERTON
Manager, Public Relations
Ryan Aeronautical Co.
San Diego, Calif.

Safety Queries

With all the current furor over airline safety, and with Mr. Quesada apparently directing all his efforts to correct same to a "hard core of pilots," we would like to wonder out loud about some of the following:

First, why is the DC-3 still flying? Here is an airplane that does not now nor has it ever complied with the minimum requirements for transport category aircraft certification. Yet it operates under a continuing exemption issued by Gen. Quesada, whose avowed primary concern is for passenger safety. Perhaps the convenience of some airlines comes first with passenger safety taking second place.

Secondly, it seems that while Gen. Quesada demands that both pilot and copilot remain rigidly strapped in their seats (justifiably so) he thinks that for maximum passenger safety only one of these men need to know how to fly the airplane into which he is so rigidly strapped. Could it be that fully qualified copilots might cost some ATA member more than just a little inconvenience?

The FAA, presumably at Gen. Quesada's direction, has decided that "no facts have been developed to indicate that consumption of alcoholic beverages on airliners poses a safety problem." This is a remarkable conclusion, about the same as saying that drunken drivers are no safety problem. It is inconceivable that an agency charged with ensuring passenger safety could draw such a conclusion.

Why has the general taken so long and been so liberal in the directive to require airborne radar on all commercial aircraft? Do you suppose the convenience of some ATA member(s) had anything to do with this?

Mr. Quesada, in testifying before the current Senate committee, was quoted as saying something like he had been "close to revoking the certificates of some carriers, but he feared for their financial well-being." Is this a case of financial solvency first and passenger safety second? It would seem so.

Mr. Quesada has apparently decided that what he needs is a whipping boy; one who has no chance for rebuttal, either political or otherwise. And who else than the ALPA; they have no political influence, no union influence and no money for those purposes.

Now I'm not much of an ALPA member, and I disagree with the policy about as much as I agree, which is about par for a democratic organization. But when Mr. Quesada refers to that "hard core of pilots" that are against him he is referring to about 99.99% of the ALPA, and I understand to the same percentage of the AOPA, as well.

All members are against: (1) airborne drinking; (2) radarless airliners; (3) unqualified copilots; (4) unsafe airplanes; (5) high handed military-like tactics of a supposedly civil organization; and (6) compulsory retirement at any age.

Incidentally, the line I fly for has 100% ATR rated pilots (copilots included) who take regular hood checks (copilots included), pilot qualified engineers, and radar on every plane.

V. C. KREBS
(Eight Year Copilot, Age 37)
United Air Lines
Los Angeles, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

FAA/ALPA Disputes

I have reviewed a number of recent editions of AVIATION WEEK, including the current issue (Feb. 1), and found that a common point in each edition is a report of an Air Line Pilots Assn. objection to one or another ruling of the Federal Aviation Agency or the Civil Aeronautics Board. By way of proof I cite the following examples:

"Retirement Rules Fight Planned By ALPA in Court, Congress" (Dec. 14, p. 41).

"Copilot Rules Will Be Bargaining Issue" (Dec. 21, p. 27).

"Pilots, Carriers Debate FAA Plan To Alleviate Los Angeles Noise" (Jan. 4, p. 26).

"FAA-ALPA Battle Forum" (Jan. 11, p. 25).

"Quesada Says Laxness Indicated In FAA Aviation Safety Survey" (Jan. 18, p. 37).

"Sayen Charges FAA Program Causes Pilot 'Resentment, Anxiety'" (Jan. 25, p. 38).

"Pilots Seek Injunction to Block FAA-Imposed Retirement Ruling" (Feb. 1, p. 33).

I am not a pilot, neither commercial nor private, and am not connected in any way with the airline industry, except as a passenger (for a considerable number of miles annually). My principal interest in the operation of the airlines is a certain concern that the cockpit crew is staffed with personnel well qualified technically and physically to operate the aircraft and of such disposition as to pay a high regard for the rules and regulations concerning aerial navigation which have been promulgated for the common welfare and safety. I consider that the retirement at age 60 ruling recently established by the Federal Aviation Agency is one such ruling, and that protests against this ruling by special interest groups such as the Air Lines Pilots Assn. are not for the common safety or welfare.

I do not know of a procedure whereby airline passengers can effect directly within the Air Line Pilots Assn. the high regard for the ruling of a duly constituted executive agency required by good judgment and consideration for the common welfare and safety. I do suggest, however, that certain economic pressures could be brought to bear on members of the association if passengers were to boycott airlines that staff cockpit crews with employes in excess of the maximum age established by the Federal Aviation Agency.

ROBERT B. BOSE
Syracuse, N. Y.

First Into Space

With every missile fizzle,
There's a lot of Congressional dribble.
So let us resolve this race,
And send a Congressman first into space!

R. A. MCFANN
Seattle, Wash.

Radiation's Facilities

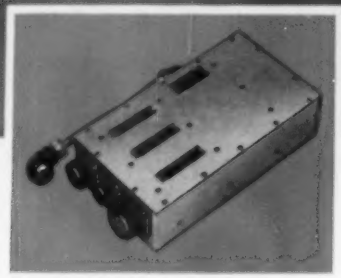
Your Nov. 16 "Industry Observer" column contained a misleading statement concerning construction of new facilities by Radiation, Inc. at Palm Bay, Fla. The facilities have not been built under subcontract from Boeing Airplane Co. for Minuteman, as stated in "Industry Observer."

This development is part of a dynamic multimillion dollar expansion program. The new industrial complex houses Radiation's national headquarters, consisting of a 42,900 sq. ft. administration building, and a group of 22,000 sq. ft. engineering modules already completed. Investment at this stage totals $1,250,000.

Radiation has complete responsibility for PCM telemetry for the Minuteman ICBM, including airborne and ground portions as well as a tape format converter. Radiation's additional plants are located in Orlando, Fla.; Palo Alto and Mountain View, Calif.

LOUIS P. CLARK, JR.
Public Relations Director
Radiation, Inc.
Melbourne, Fla.

Another example of LFE capability in airborne electronics



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...ED BY RADAR

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Commercial airlines use Varian klystron-equipped weather radar to assure the comfort and safety of passengers and the reduction to a minimum of storm hazards and delays. Photo above shows radar antenna inside the Radome nose of a United Air Lines plane.

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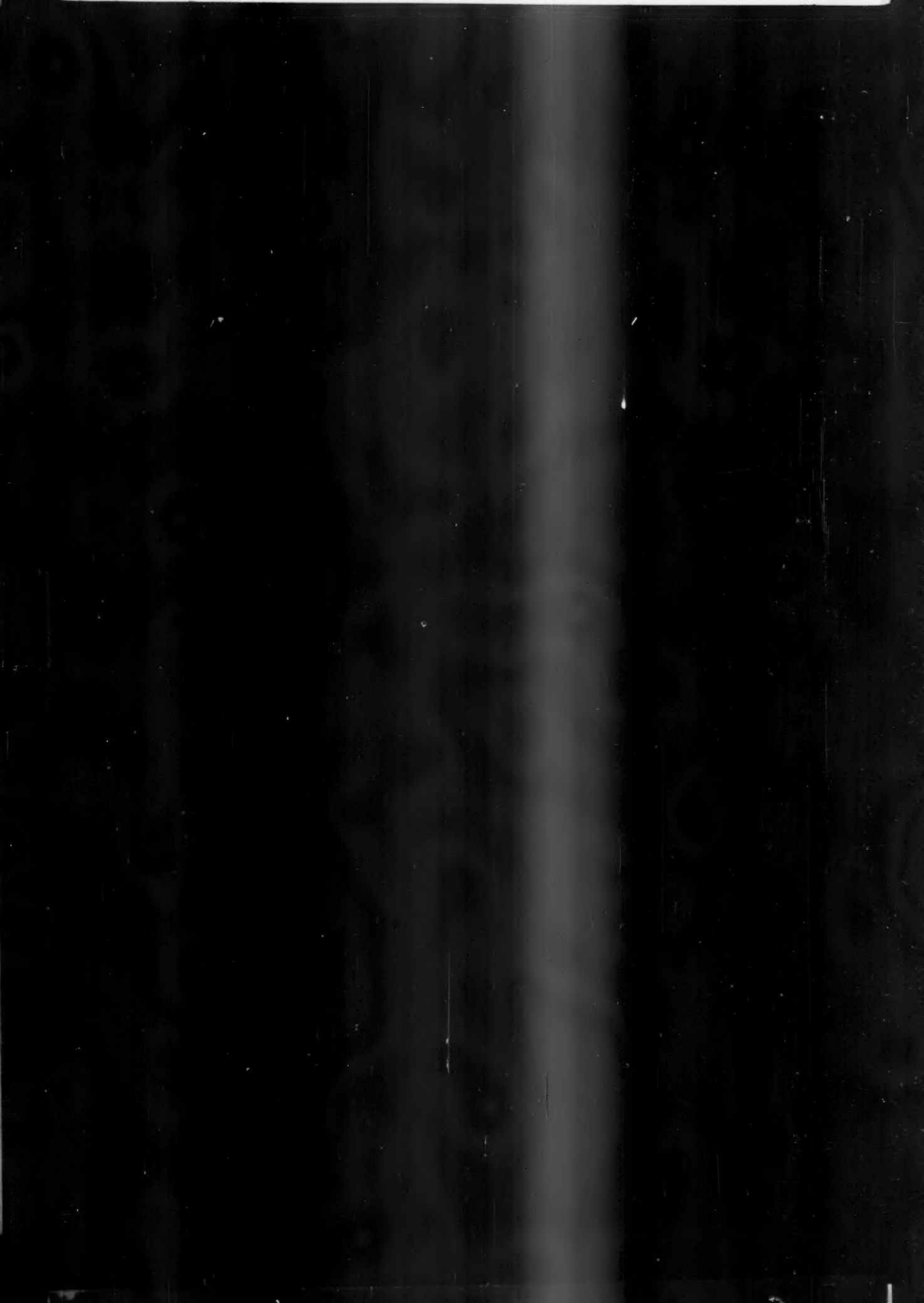
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